Compaq Smart Array 5i Plus Controller and Battery Backed Write Cache Enabler

User Guide

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COMPAQ

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About This Guide

This guide provides step-by-step instructions for installation, and reference information for operation and troubleshooting for the Compaq Smart Array 5i Plus Controller and Battery Backed Write Cache Enabler.

⚠ Important Safety Information

Before installing this product, read the *Important Safety Information* document provided.

Symbols on Equipment

The following symbols may be placed on equipment to indicate the presence of potentially hazardous conditions.

WARNING: This symbol, in conjunction with any of the following symbols, indicates the presence of a potential hazard. The potential for injury exists if warnings are not observed. Consult your documentation for specific details.

This symbol indicates the presence of hazardous energy circuits or electric shock hazards. Refer all servicing to qualified personnel.

WARNING: To reduce the risk of injury from electric shock hazards, do not open this enclosure. Refer all maintenance, upgrades, and servicing to qualified personnel.

This symbol indicates the presence of electric shock hazards. The area contains no user or field serviceable parts. Do not open for any reason.

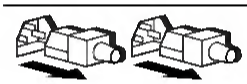
WARNING: To reduce the risk of injury from electric shock hazards, do not open this enclosure

This symbol on an RJ-45 receptacle indicates a network interface connection.

WARNING: To reduce the risk of electric shock, fire, or damage to the equipment, do not plug telephone or telecommunications connectors into this receptacle.

This symbol indicates the presence of a hot surface or hot component. If this surface is contacted, the potential for injury exists.

WARNING: To reduce the risk of injury from a hot component, allow the surface to cool before touching.



These symbols, on power supplies or systems, indicate that the equipment is supplied by multiple sources of power.

WARNING: To reduce the risk of injury from electric shock, remove all power cords to completely disconnect power from the system.

This symbol indicates that the component exceeds the recommended weight for one individual to handle safely.

Weight in kg
Weight in lb

WARNING: To reduce the risk of personal injury or damage to the equipment, observe local occupational health and safety requirements and guidelines for manual material handling.

Symbols in Text

These symbols may be found in the text of this guide. They have the following meanings.

WARNING: Text set off in this manner indicates that failure to follow directions in the warning could result in bodily harm or loss of life.

CAUTION: Text set off in this manner indicates that failure to follow directions could result in damage to equipment or loss of information.

IMPORTANT: Text set off in this manner presents clarifying information or specific instructions.

NOTE: Text set off in this manner presents commentary, sidelights, or interesting points of information.

Text Conventions

This document uses the following conventions:

- *Italic type* indicates complete titles of manuals or variables. Variables include information that varies in system output, in command lines, and in command parameters in text.
- **Bold type** is used for emphasis, for onscreen interface components (window titles, menu names and selections, button and icon names, and so on), and for keyboard keys.
- `Monospace typeface` is used for command lines, code examples, screen displays, error messages, and user input.
- Sans serif typeface is used for uniform resource locators (URLs).

Related Documents

For additional information on the topics covered in this guide, refer to the following documentation:

- *Compaq Array Configuration Utility XE User Guide*
- *Compaq servers Troubleshooting Guide*

Getting Help

If you have a problem and have exhausted the information in this guide, you can get further information and other help in the following locations.

Compaq Technical Support

In North America, call the Compaq Technical Support Phone Center at 1-800-OK-COMPAQ. This service is available 24 hours a day, 7 days a week. For continuous quality improvement, calls may be recorded or monitored. Outside North America, call the nearest Compaq Technical Support Phone Center. Telephone numbers for worldwide Technical Support Centers are listed on the Compaq website, www.compaq.com.

Be sure to have the following information available before you call Compaq:

- Technical support registration number (if applicable)
- Product serial number
- Product model name and number
- Applicable error messages
- Add-on boards or hardware
- Third-party hardware or software
- Operating system type and revision level

Compaq Website

The Compaq website has information on this product as well as the latest drivers and flash ROM images. You can access the Compaq website at www.compaq.com.

Compaq Authorized Reseller

For the name of your nearest Compaq authorized reseller:

- In the United States, call 1-800-345-1518.

- In Canada, call 1-800-263-5868.
- Elsewhere, see the Compaq website for locations and telephone numbers.

Reader's Comments

Compaq welcomes your comments on this guide. Please send your comments and suggestions by email to `ServerDocumentation@compaq.com`.

1

Features

The Smart Array 5i Plus Controller and Battery Backed Write Cache EnabIer is a Wide Ultra3 SCSI hard drive array controller with a 64-MB read/write embedded cache and a Battery Backed Write Cache Enabler, which provides transportable data protection and increases overall controller performance.

Overview of Controller Features

- Has dual Wide Ultra3 SCSI channels supporting up to I4 drives
- Supports the following operating systems:
  - — Microsoft Windows 2000
  - — Microsoft Windows NT 4.0
  - — NovelI Netware 5.X and 6.X
  - — Linux (Refer to the Compaq website for further information about Linux version support.)
  - — SCO UnixWare 7.XX
- Supports the Compaq Universal Hot-Plug Tape Drive
- Supports drive and array movement to the Smart Array 532, Smart Array 5302/5304 and Smart Array 5i controllers
- Provides backward compatibility with Wide Ultra2 SCSI devices
- Uses a 32- or 64-bit PCI bus master interface
- Has a user selectable read or optional write cache allocation from 0-64 MB

- Has a Battery Backed Write Cache Enabler
- Supports these additional features:
  - — RAID (0, 1 + 0, 5)
  - — Online RAID migration between any two levels
  - — Online array capacity expansion
  - — Adjustable stripe size
  - — Performance monitoring with *Compaq Insight Manager*™
  - — S.M.A.R.T. paging
  - — Drive pre-failure notification
  - — Tagged command queuing
  - — Multiple logical drives per array
  - — Compaq Pre-Failure Warranty and Pre-Failure Notification for Compaq drives (requires Compaq Insight Manager)
  - — Easy-to-use Compaq Array Configuration Utility (ACU) and browser-based Compaq Array Configuration Utility XE (ACU-XE)
  - — Option ROM Configuration for Arrays (ORCA) Utility
  - — Redundant ROM

Battery Backed Write Cache Enabler

A Battery Backed Write Cache Enabler is included with the Smart Array 5i Plus Controller. Also called the battery module, this component enables write cache, provides transportable data protection, increases overall controller performance, and maintains any cache data for up to 72 hours.

NOTE: The data protection (and the time limit) also applies if a power outage occurs. When power is restored to the system, an initialization process writes the preserved data to the hard drives.

The NiMH batteries in the battery module are continuously recharged through a trickle charging process whenever the system power is on. Under normal operating conditions, the battery module lasts for three years before replacement is necessary.

IMPORTANT: The battery module may have a low charge when it is first installed. In this case, a Power-On Self-Test (POST) message 1794 is displayed when the server is powered up (see Appendix F), indicating that the array accelerator is temporarily disabled. No action is required on your part, since the internal circuitry automatically recharges the batteries. The recharge process can take up to four hours. The array controller will function properly during this time, although without the performance advantage of the array accelerator. When the batteries are charged to 79 percent of their capacity, the array accelerator is automatically enabled.

The battery module can be removed from the server without using any tools. For detailed instructions, refer to the documentation that ships with your server and with the option kit.

CAUTION: When using the battery module, observe the following limitations:

- Do not transfer the battery module between different server models.
- Do not add or remove the battery module while array capacity expansion, RAID level migration, or stripe size migration is in progress.

The battery module has two LEDs, one green and one amber. When the battery module is connected to the controller and the server is powered up, the green LED indicates the status of the battery charge. When the battery is connected to the controller and the server is powered down, the amber LED indicates the status of data retention. See Table 1-1 for an interpretation of the possible LED illumination patterns.

CAUTION: After the server is powered down, wait 15 seconds and then check the illumination pattern of the LEDs before unplugging the cable from the battery module.

- If the amber LED blinks after 15 seconds, do not remove the cable from the battery module. The module is backing up data, and data will be lost if the cable is detached.
- If neither LED blinks after 15 seconds, it is safe to remove the cable from the battery module.

When the server is on, review the POST message before plugging or unplugging the cable from the battery module.

Table 1-1: Battery Module LED Descriptions

Server Status	LED Color	LED Status	Battery Module Status
Server is on and has normal run time	Green	On	Fast charging
	Green	Off	Trickle charging
	Amber	On	Short in the connection of one or more of the four button cells within the battery module
	Amber	Blinking	Open in the circuit between the positive and negative terminals of the battery module
	Amber	Off	Battery module status is normal
Server is on and is in the first 30 seconds after power-up	Amber and green	On	Temporary lock-out state, data was lost due to cable being detached
Server is off and is in data retention mode	Amber	Blinking every 15 seconds	User data held in write cache is being backed up

Memory

The Smart Array 5i Plus Controller and Battery Backed Write Cache Enabler has a 64-MB write cache with PC100, CL2 SDRAM memory.

Controller Interface

The Smart Array 5i Plus Controller and Battery Backed Write Cache Enabler interfaces to the server through a high-performance 32- or 64-bit PCI bus that:

- Provides a high-speed path (up to 533 MB/s between the system board and the controller)
- Has multiplexed address and data lines
- Includes a parity protection signal

The Smart Array 5i Plus Controller and Battery Backed Write Cache Enabler is a PCI bus master device conforming to the PCI Local Bus Specification. As a bus master device, it takes control of the PCI bus during high-speed transfers, freeing the system processor to handle application processing or other types of tasks.

SCSI Support

The Smart Array 5i Plus Controller and Battery Backed Write Cache Enabler supports Wide Ultra3 and Wide Ultra2 SCSI devices that use Low Voltage Differential Signaling (LVDS) on the SCSI bus.

The Smart Array 5i Plus Controller and Battery Backed Write Cache Enabler does not support Wide SCSI-3 devices that use the Single-Ended (SE) signaling protocol.

Drive Array Technology

Drive array technology distributes data across a series of hard drives to unite physical drives into one or more logical drives. This technology enables concurrent access to data on multiple drives in the array and yields faster input/output rates than those using non-arrayed drives. You may set each logical drive in the array to a different fault-tolerant configuration. The Smart Array 5i Plus Controller and Battery Backed Write Cache Enabler manages the drive array independent of the host processor.

The Compaq ACU-XE, a browser-based utility, helps you configure the hardware in the way that best suits your needs. Refer to the Compaq *SmartStart*™ and Support CD for additional information.

See Appendix C, "Drive Arrays and Fault Tolerance," for general information about drive arrays.

Fault Management Features

The array controller and the network operating system support several fault management and data reliability features that minimize the impact of hard drive defects on your system.

- **Auto Reliability Monitoring** (ARM) is a background process that scans hard drives for bad sectors in fault-tolerant logical drives. ARM also verifies the consistency of parity data in logical drives that are using RAID 5. This process assures that you can recover all data successfully if a drive failure occurs in the future. ARM operates only when you select RAID 1 or RAID 5.
- **Dynamic sector repair** by the controller automatically remaps any sectors that have media faults (detected either during normal operation or by auto reliability monitoring).
- **Drive parameter tracking** monitors more than 15 drive operational parameters and functional tests, allowing the array controller to detect drive problems and predict drive failure before it occurs. This feature makes possible the Compaq Pre-Failure Warranty on Compaq hard drives.

  Parameters that are tracked include read, write, and seek errors; spin-up time; cable problems; and functional tests such as track-to-track seek time, and one-third stroke, and full-stroke seek time.
- **Drive failure alert features** cause an alert message to be displayed on the system monitor when drive failure occurs. Different Compaq server models use different messages for different situations. These messages are described in your server documentation.
- **Interim data recovery** occurs if a drive fails in fault-tolerant configurations (RAID 1 or RAID 5). In this situation, the system will still process I/O requests, but at a reduced performance level. Replace the failed drive as soon as possible to restore performance and full fault tolerance for that logical drive. Otherwise, if another hard drive fails before data has been rebuilt, the logical volume will fail and data will be lost. See Appendix D for more information about recovering from drive failure.

- **Predictive failure alert** is a powerful problem-prevention feature that warns you when a drive failure is imminent. This feature allows you to take corrective action with minimal effect on critical business operations. Your system must use Compaq Insight Manager and a Compaq Smart Array controller to benefit from predictive failure alert.

  Instructions for using the predictive failure alert feature can be found in the documentation for Compaq Insight Manager software and Compaq Management Agents. This documentation is located on the Compaq Management CD.

  NOTE: An online spare will not become active and start rebuilding after a predictive failure alert, because the degraded drive has not actually failed yet and is still online. The online spare is activated only after a drive in the array has failed.

- **POST** or the **Array Diagnostics Utility** (ADU) also reveals imminent drive failure.

- **Recovery ROM** is a controller redundancy feature that ensures continuous system availability by providing a backup ROM. This feature protects against corruption of a ROM image (caused, for example, by power fluctuation during ROM upgrade). If corruption occurs, the server automatically restarts using the remaining good copy of the ROM image.

  When you upgrade the ROM, the inactive image (the one not being used by the system) is upgraded. There is not normally any noticeable difference in operation. When you use Recovery ROM for the first time, however, the backup ROM images are upgraded, causing a boot delay of about 20 seconds.

Other Compaq options, such as Compaq Insight Manager, provide additional drive failure features. See your Compaq authorized reseller for more information about these products.

2

Installation Overview

The details of the steps required to install the controller depend on whether the server has an operating system installed and contains data. The flowcharts in Figure 2-1 and Figure 2-2 summarize the installation procedures for the most common scenarios.

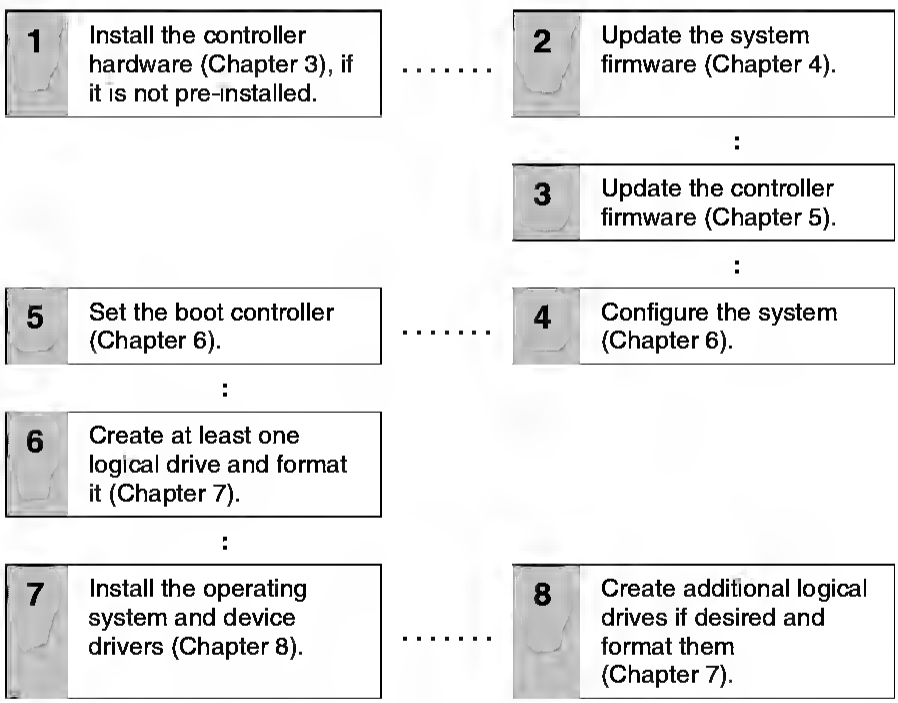

1
Install the controller hardware (Chapter 3), if it is not pre-installed.
2
Update the system firmware (Chapter 4).
3
Update the controller firmware (Chapter 5).
4
Configure the system (Chapter 6).
5
Set the boot controller (Chapter 6).
6
Create at least one logical drive and format it (Chapter 7).
7
Install the operating system and device drivers (Chapter 8).
8
Create additional logical drives if desired and format them (Chapter 7).

Figure 2-1: Controller installation in a new system

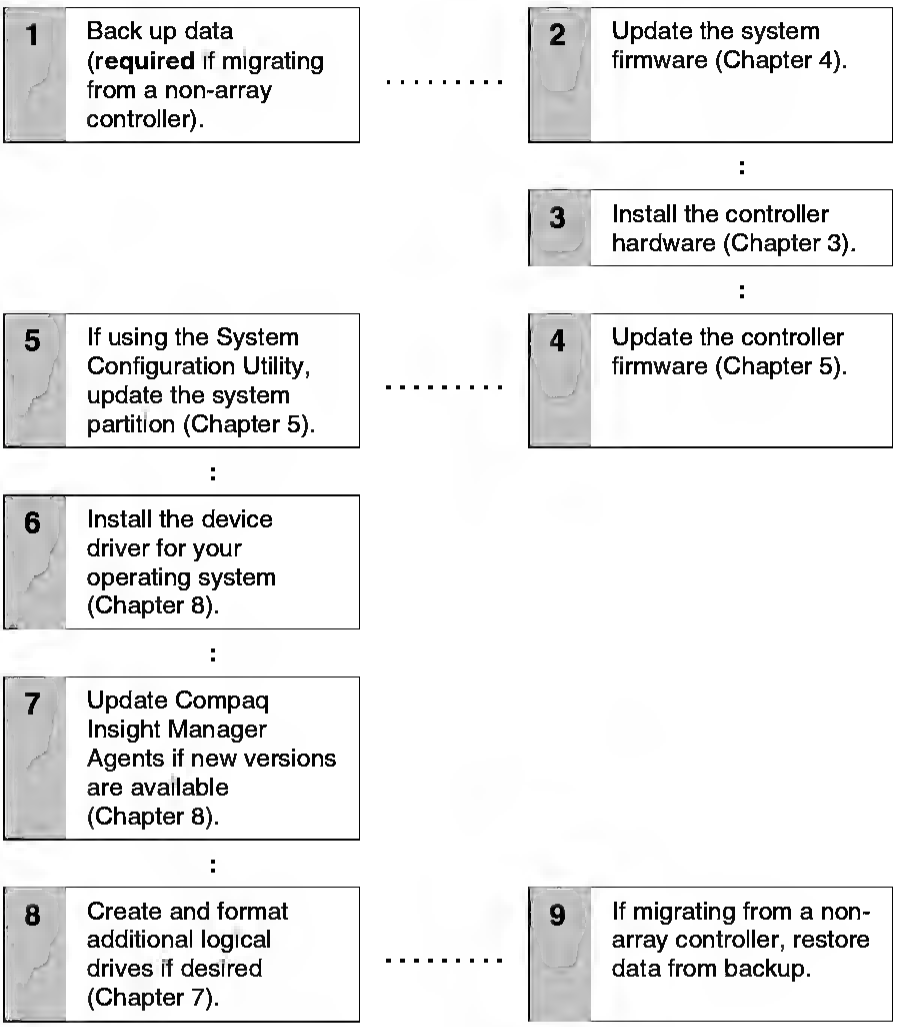

1
Back up data (**required** if migrating from a non-array controller).
2
Update the system firmware (Chapter 4).
3
Install the controller hardware (Chapter 3).
4
Update the controller firmware (Chapter 5).
5
If using the System Configuration Utility, update the system partition (Chapter 5).
6
Install the device driver for your operating system (Chapter 8).
7
Update Compaq Insight Manager Agents if new versions are available (Chapter 8).
8
Create and format additional logical drives if desired (Chapter 7).
9
If migrating from a non-array controller, restore data from backup.

Figure 2-2: Controller installation in a previously configured system

3

Installing the Smart Array 5i Plus Controller and Battery Backed Write Cache Enabler

WARNING: To reduce the risk of personal injury or damage to the equipment, be aware of the precautions you need to follow when setting up the system or handling parts. A discharge of static electricity from a finger or other conductor may damage system boards or other static-sensitive devices.

Many servers are also capable of producing energy levels that are considered hazardous. These servers are to be serviced by qualified personnel trained to deal with these hazards. Do not remove enclosures or attempt to bypass any interlocks that may be provided for the purpose of removing these hazardous conditions.

Consult the safety information and user documentation provided with your server before attempting the installation.

To install the Smart Array 5i Plus Controller and Battery Backed Write Cache Enabler:

1. Back up all data. This step is **mandatory**.

   CAUTION: Back up all data stored on existing drives before installing the controller. All data stored on non-array drives is destroyed when the new controller is installed.

2. Close all applications.
3. Power down the server.

   CAUTION: In systems using external data storage, be sure that the server is the first unit powered down and the last to be powered back up. Doing this ensures that the system will not erroneously mark the drives as failed.

4. Power down any peripheral devices attached to the server.
5. Unplug the AC power cord from the outlet, then from the server.
6. Disconnect any peripheral devices from the server.

WARNING: To reduce the risk of personal injury from hot surfaces, allow the internal system components and hot-plug hard drives to cool before touching them.

7. Remove or open the access panel.
8. Install the Smart Array 5i Plus Controller and Battery Backed Write Cache Enabler option. Refer to the documentation that ships with your server and with the option kit.
9. Restore all data from the backup you performed in step 1.

CAUTION: Any information that was not backed up before installation is permanently deleted when the system is powered up.

10. Use the Smart Array 5i Plus Controller utilities for configuration:
    a. Run the ORCA utility to configure the first array and logical drive.
    b. Install your operating system.
    c. Run ACU-XE tools to configure and manage server storage with the Smart Array 5i Plus Controller.

Installation is complete.

4

Updating the System Firmware

Before installing an array controller in a Compaq server, update the system firmware by running the System *ROMPaq*™ utility.

NOTE: This utility is not to be confused with the Options ROMPaq utility (see Chapter 5), which is used to update the firmware on server options and SCSI drives.

The System ROMPaq utility has two main sources:

- The SmartStart and Support Software CD that is either shipped with your server or available directly from Compaq
- The downloadable *SoftPaq*™ file on the Compaq website

If your server has a bootable CD-ROM drive, you can run System ROMPaq directly from the CD. Otherwise, you must run System ROMPaq from a diskette created from either the CD or from the SoftPaq file.

IMPORTANT: Compare the version numbers of the System ROMPaq utility from these two sources. If the CD version is older, use the SoftPaq file instead.

If your system uses the System Configuration Utility (SCU), you may also need to update the system partition to complete the system update.

Running System ROMPaq from the CD

1. Boot the server from the SmartStart and Support Software CD.
2. On the **Compaq System Utilities** screen, select **Run ROMPaq.**
3. Follow the on-screen prompts and instructions to reprogram your system ROM.

Running System ROMPaq from Diskette

To run System ROMPaq from diskette, you must first create a System ROMPaq diskette from the CD or from the appropriate SoftPaq file.

Creating a System ROMPaq Diskette from the CD

1. Insert the SmartStart and Support Software CD into the CD-ROM drive tray of a server with a bootable CD-ROM drive.
2. Restart the server.
3. On the **Compaq System Utilities** screen, select **Create Support Software.**
4. On the **Diskette Builder** menu screen, scroll through the list and select **System ROMPaq Firmware Upgrade Diskette,** and then click **Next**.
5. Click **Create Diskettes Only**, and then click **Next.**
6. Follow the remaining instructions on the screen to create the System ROMPaq diskette.
7. To update the firmware, follow the procedure given in the section "Using the Diskette."

Creating a System ROMPaq Diskette from the SoftPaq File

1. Create a temporary directory on your hard drive.
2. Go to the Compaq website, www.compaq.com.
3. Locate the page containing the SoftPaq file for the System ROMPaq utility.
4. Click the link for the System ROMPaq SoftPaq file.

5. Click **Download**, and then direct the download to the temporary directory that you created.
6. Click **Save.**
7. Execute the downloaded SoftPaq file and follow the on-screen instructions to create the System ROMPaq diskette.
8. To update the firmware, follow the procedure given in the section "Using the Diskette."

Using the Diskette

1. With the server powered down, place the System ROMPaq diskette in the diskette drive.
2. Power up the server.
3. When the **Welcome** screen is displayed, press the **Enter** key.
4. When the **Select A Device** screen is displayed, select your server from the list of programmable devices, and then press the **Enter** key.

   The **Select An Image** screen is displayed, showing the following information:

   ```
   Device to reprogram:          your server
   Current ROM revision:         date of existing ROM version
   Select Firmware Images:       date of latest ROM version
   ```

5. Press the **Enter** key. The **Caution** screen is displayed.
6. Press the **Enter** key. The following message is displayed:

   ```
   Reprogramming Firmware
   ```

   Do not interrupt the reprogramming process. You will be notified when reprogramming is complete.
7. When reprogramming has finished, press the **Esc** key to exit the utility.
8. Remove the System ROMPaq diskette and restart the server.

5

Updating the Controller Firmware

You can update the firmware on Compaq options by using the Options ROMPaq utility. There are two versions of this utility: Options ROMPaq for Array Controllers and Options ROMPaq for Internal (SCSI Attached) Drives.

If you purchased your server with an array controller already installed, you do not need to run this utility during server installation. However, if you have older Smart Array Controllers or other Compaq options (such as drives), run Options ROMPaq to make sure that these devices have the latest firmware. Compaq recommends that you run the latest Options ROMPaq on all Compaq array controllers whenever new versions of the utility are released.

The Options ROMPaq utility has two main sources:

- Smart Array Controller Support Software CD
- The downloadable SoftPaq file on the Compaq website

If your server has a bootable CD-ROM drive, you can run Options ROMPaq directly from the Smart Array Controller Support Software CD. Otherwise, you must run Options ROMPaq from a diskette created from the CD or from the SoftPaq file.

IMPORTANT: Compare the version numbers of the Options ROMPaq utility from these two sources. If the CD versions are older, use the SoftPaq file instead.

Running Options ROMPaq from the Smart Array Controller Support Software CD

1. Place the Smart Array Controller Support Software CD in the server CD-ROM drive.
2. Restart the server.
3. When the **Compaq System Utilities** screen is displayed, select **Run Options ROMPaq** and then press the **Enter** key.
4. When the **Welcome** screen is displayed, press the **Enter** key.
5. On the **Select A Device** screen, select **All Compaq Smart Array *nnnn* Controller(s)** from the list of programmable devices, and then press the **Enter** key.
6. The action that you must now take depends on the message on the screen:
   - — If the screen message reads as follows, press the **Enter** key, and then go to step 8 of these instructions:

     ```
     The ROM image files found for the device selected are not
     newer than the current ROM image
     ```

   - — If the ROM firmware currently on the controller is older than that on the Options ROMPaq diskette, then the screen message reads as follows:

     ```
     Device to reprogram:    All Compaq Smart Array nnnn
     Controller(s)
     Controller(s) Current ROM revision: Compaq Smart Array
     nnnn Controller x.xx
     Select Firmware Images: Compaq Smart Array nnnn
     Controller y.yy
     ```

     In this case, press the **Enter** key and then go to step 7.
7. Review the information on the **Caution** screen, and then press the **Enter** key to reprogram the controller ROM.

   The following message is displayed:

   ```
   Reprogramming Firmware
   ```

   Do not interrupt the reprogramming process. You will be notified when reprogramming is complete.

8. When reprogramming of the controller ROM is finished, you can reprogram more options or exit the utility.
   - — To reprogram another Compaq option, press the **Enter** key, and then repeat steps 5 through 7.
   - — If you have finished reprogramming Compaq options, press the **Esc** key to exit the utility.
9. Remove the CD and restart the server.

Running Options ROMPaq from Diskettes

To run Options ROMPaq from diskette, first create Options ROMPaq diskettes from one of the CDs or from the appropriate SoftPaq file.

Creating Diskettes Using the Smart Array Controller Support Software CD

1. Insert the Smart Array Controller Support Software CD into the server CD-ROM drive tray.
2. Open the **OPTRMDSK** folder on the CD and execute the QRST5.EXE file.
3. Follow the on-screen prompts to create the set of Options ROMPaq diskettes.
4. To complete the firmware update, follow the procedure given in the section "Using the Diskettes."

Creating Diskettes Using the SmartStart and Support Software CD

1. Insert the SmartStart and Support Software CD into the CD-ROM drive tray of a server with a bootable CD-ROM drive.
2. Restart the server.
3. On the **Compaq System Utilities** screen, select **Create Support Software.**
4. On the **Diskette Builder** menu screen, scroll through the list and select **Options ROMPaq,** and then click **Next.**
5. Click **Create Diskettes Only** and then click **Next.**

6. Follow the remaining on-screen instructions to create the Options ROMPaq diskettes.
7. To complete the firmware update, follow the procedure given in the section "Using the Diskettes."

Creating Diskettes Using the SoftPaq File

1. Create a temporary directory on your hard drive.
2. On the Compaq website, locate the page containing the SoftPaq file for the Options ROMPaq utility.
3. Click the link for the Options ROMPaq SoftPaq file.
4. Click **Download**, and direct the download to the temporary directory that you created.
5. Click **Save.**
6. Execute the downloaded SoftPaq file and follow the on-screen instructions to create the diskette. Up to six diskettes are needed for the Options ROMPaq SoftPaq file.
7. To complete the firmware update, follow the procedure given in the section "Using the Diskettes."

Using the Diskettes

1. Be sure that the server is off.
2. Insert the first Options ROMPaq diskette into the diskette drive.
3. Restart the server.
4. When the **Welcome** screen is displayed, press the **Enter** key. The **Select a Device** screen is displayed.

   If the controller that you want to update the firmware for is on the list of programmable devices, select it and press the **Enter** key. (If it is not present, you are prompted to insert the remaining diskettes for devices not listed on the first diskette.)
5. The action that you must now take depends on the message on the screen:

— If the screen message reads as follows, press the **Enter** key, and then go to step 8 of these instructions:

```
The ROM image files found for the device selected are not
newer than the current ROM image
```

— If the ROM firmware currently on the controller is older than that on the Options ROMPaq diskette, then the screen message reads as follows:

```
Device to reprogram:    All Compaq Smart Array nnnn
Controller(s)
Controller(s) Current ROM revision: Compaq Smart Array
nnnn Controller x.xx
Select Firmware Images: Compaq Smart Array nnnn
Controller y.yy
```

In this case, press the **Enter** key and then go to step 7.

6. Review the information on the **Caution** screen, and then press the **Enter** key to reprogram the controller ROM.

   The following message is displayed:

   ```
   Reprogramming Firmware
   ```

   Do not interrupt the reprogramming process. You will be notified when reprogramming is complete.

7. When the reprogramming of the controller ROM is finished, you can reprogram more options or exit the utility.

   — To reprogram another Compaq option, press the **Enter** key, and then repeat steps 5 through 7.

   — If you have finished reprogramming Compaq options, press the **Esc** key to exit the utility.

8. Remove the Options ROMPaq diskette and restart the server.

Updating the System Partition

If you are installing the controller on a server that was previously configured with SCU, you must now use this utility to update the system partition.

NOTE: If your server uses the ROM-Based Setup Utility (RBSU), you do not need to run SCU.

SCU is provided on both the SmartStart and Support Software CD and the Smart Array Controller Support Software CD. Compare the SCU version numbers from these two sources and use the most recent version.

NOTE: Before updating NetWare volumes or partitions, remember these tips to optimize system performance:

- If you want to use hardware-based RAID, do not select mirroring while using INSTALL.NLM or NWCONFIG.NLM.
- Novell recommends that you create volumes with a 64-kbyte block size to decrease the amount of RAM required to mount the volume, and use the Block Sub-Allocation feature to allow disk space to be allocated more efficiently.
- Linear memory provides the best system performance in the NetWare environment. If you previously used SCU to configure your server, this option would have been the default. To check that the system is using linear memory, run SCU and view the Compaq memory settings. Be sure that a linear option is selected under the **Base Memory** option.

1. Restart the server from the CD.
2. If the CD-ROM drive is bootable, go to step 5. Otherwise, locate the *CD-ROM drive*:\SYSCFDSK\US directory, run the file QRST5.EXE, and follow the on-screen instructions to create four SCU diskettes.
3. Insert SCU diskette #1 into the server diskette drive.
4. Restart the system.
5. Select **System Configuration Utility** from the menu or list of icons that is displayed.
6. Follow the on-screen instructions to update or create and populate a system partition.
7. Exit from the SCU.

If the server does not reboot or a CD error message is displayed, press the **Ctrl+Alt+Del** keys to continue and reboot the server.

6

Configuring the System

When installing a controller in a **new** system, perform these tasks after installing the controller and updating the controller firmware:

- Configure the system by using either the ROM-Based Setup Utility (RBSU) or the System Configuration Utility (SCU), following the procedure given in the server user guide.
- Set the boot controller by using RBSU, or the Option ROM Configuration for Arrays (ORCA) utility (described in this chapter).
- Create at least one logical drive by using ORCA or ACU (as described in Chapter 7).

Using RBSU

RBSU is a system configuration utility that is embedded in the system ROM, and is customized for the server on which it is installed. RBSU is updated by using System ROMPaq.

IMPORTANT: Not all servers support RBSU.

To use RBSU:

1. Power up the server.

2. Press the **F9** key when prompted during system startup.

   The **ROM-Based Setup Utility** menu screen is displayed.

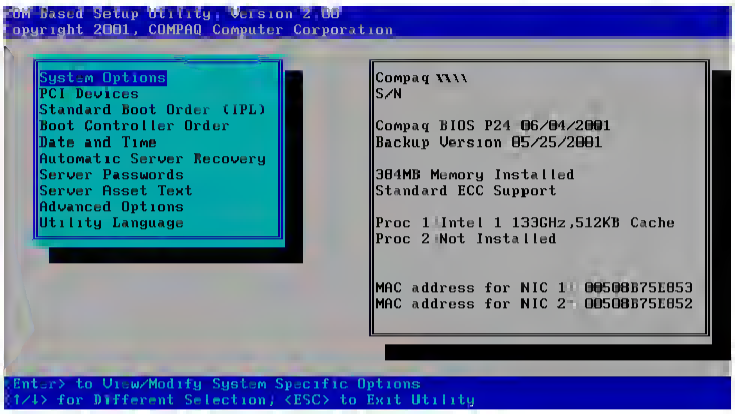


Figure 6-1: RBSU menu screen

3. Configure your system. (For detailed instructions, refer to the *Compaq ROM-Based Setup Utility User Guide.*)
4. Set the boot controller by selecting **Boot Controller Order** on the **RBSU** menu screen and following the on-screen prompts.
5. When you have finished using the utility, press the **Esc** key, and then press the **F10** key to confirm that you want to exit RBSU.

Using ORCA

Part of the startup sequence of a server is the Power-On Self-Test (POST). If the array controller in the server supports ORCA, POST temporarily halts and an ORCA prompt message is displayed for about five seconds. (If ORCA is not supported, the prompt message is not displayed and the system continues with the startup sequence.)

1. Power up the server and let the system startup sequence begin.
2. While the prompt message is on the screen, press the **F8** key to start ORCA.
3. On the **Option ROM Configuration for Arrays Main Menu** screen, select **Select Boot Controller** and follow the prompts to set the boot controller for the system.

If you want to use ORCA to create logical drives at this point, you do not need to exit the utility yet. Continue using ORCA as described in Chapter 7.

7

Configuring an Array

Compaq provides four utilities for configuring an array:

- **Option ROM Configuration for Arrays (ORCA)**—a simple ROM-based configuration utility that runs on all operating systems
- **Array Configuration Utility (ACU)**—a versatile configuration utility that provides maximum control over configuration parameters
- **Array Configuration Utility-XE (ACU-XE)**—a browser-based version of ACU that can be used remotely on systems that are also running Compaq Insight Manager XE
- **NetWare Online Array Configuration (CPQONLIN) Utility**—a menu-driven utility for NetWare

The following limitations apply to all configuration methods:

- For the most efficient use of drive space, do not mix drives of different capacity within the same array. Each configuration utility treats all physical drives in an array as if they have the same capacity as the smallest drive in the array. Excess capacity of larger drives is wasted because it is unavailable to the array.
- Only one online spare drive can be assigned per array.
- The probability that an array will experience a hard drive failure increases with the number of hard drives in the array (see Appendix D). If you configure an array with RAID 5, keep the probability of failure acceptably low by using no more than 14 drives.

For more information about ACU-XE, refer to the *Compaq Array Configuration Utility XE User Guide*. For background information about drive arrays and fault-tolerance (RAID) methods, see Appendix C.

Table 7-1: Comparison of Utilities for Configuring an Array

	ACU	ACU-XE	CPQONLIN	ORCA
Uses a graphical interface	+	+	0	0
Available in languages other than English	+	+	0	0
Executable at any time	+	+	+	0
Available on CD	+	+	+	0
Uses a wizard to suggest the optimum configuration for an unconfigured controller	+	+	+	0
Describes configuration errors	+	+	0	0
Supports these operating systems:				
Windows 2000	+	+	0	+
Windows NT	+	0	0	+
NetWare	+	+	+	+
Linux	+	+	0	+
Allows these procedures:				
Creation and deletion of arrays, logical drives	+	+	+	+
Assignment of RAID level	+	+	+	+
Assignment of a spare drive	+	+	+	+
Sharing of a spare drive among several arrays	+	+	+	0
Setting of stripe size	+	+	+	0
Migration of RAID level or stripe size	+	+	+	0
Configuration of controller settings	+	+	+	0
Expansion of an array	+	+	+	0
Creation of multiple logical drives per array	+	+	0	0
Setting of boot controller	0	0	0	+

Using ORCA

When a computer system is powered up, part of the startup sequence is the Power-On Self-Test (POST). Any array controllers that are in the system are initialized while POST is running. If the array controller supports ORCA, POST temporarily halts and an ORCA prompt message is displayed for about five seconds. (If ORCA is not supported, the prompt message is not displayed and the system continues with the startup sequence.)

While the prompt is displayed, press the **F8** key to start ORCA. The **Option ROM Configuration for Arrays Main Menu** screen is displayed, allowing you to select the boot controller for the system, or to create, view, or delete a logical drive.

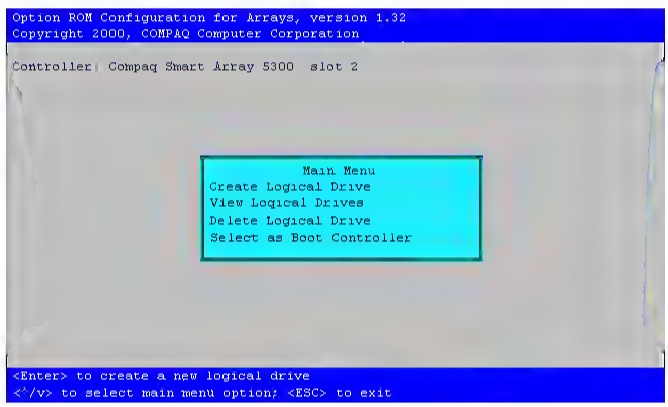

Option ROM Configuration for Arrays, version 1.32
Copyright 2000, COMPAQ Computer Corporation
Controller: Compaq Smart Array 5300 slot 2
Main Menu
Create Logical Drive
View Logical Drives
Delete Logical Drive
Select as Boot Controller
<Enter> to create a new logical drive
</v> to select main menu option; <ESC> to exit

Figure 7-1: ORCA main menu screen

To create a logical drive:

1. Choose **Create Logical Drive**.

   The screen displays a list of all available (unconfigured) physical drives and the valid RAID options for your system.

   NOTE: You can create only one logical drive at a time.

2. Use the arrow keys, space bar, and tab key to navigate around the screen and set up your logical drive, including a spare drive if required.

NOTE: ORCA allows only one array to use a given online spare.

3. Press the **Enter** key to accept the settings.
4. At the next screen, press the **F8** key to confirm your settings and save the new configuration.
5. After several seconds, the **Configuration Saved** screen is displayed. Press the **Enter** key to continue.

You can now create another logical drive on any remaining physical drives by repeating the previous steps. ORCA allows only one logical drive to be created per array; to create an array containing several logical drives, use ACU or ACU-XE.

NOTE: Raw logical drives are invisible to the operating system. To make the new logical drives available for data storage, format the logical drive using the instructions given in your operating system documentation.

Using ACU

ACU is located on the Smart Array Controller Support Software CD and on the SmartStart and Support Software CD. You can run ACU directly from one of these CDs, or—if the server you are configuring is running the Microsoft Windows NT or Windows 2000 operating system—you can download ACU onto your server and run it online.

When you start ACU, it checks the configuration of every controller and drive array. If an array is not configured optimally, the ACU configuration wizard opens and guides you through the configuration process. The wizard also helps you to configure any new controllers, assign unused physical drives to existing arrays (without destroying data), and configure any unused space present on an array into another logical drive. ACU allows you to create up to 32 logical drives per array.

If a problem arises during the configuration process, ACU displays an error message describing the problem. If the following warning message is displayed along with an error code number, call your local Compaq technical support number for assistance:

```
Internal Error Has Occurred
```

See the "About This Guide" section for technical support phone numbers.

You can view context-sensitive online help for each screen by pressing the **F1** key or clicking **Help**. The status bar at the bottom of the screen also displays messages describing the current selection.

NOTE: Raw logical drives are invisible to the operating system. To make the new logical drives available for data storage, format the logical drive using the instructions given in your operating system documentation.

Running ACU from CD

This method of running ACU is valid for Windows NT, Windows 2000, Linux, and Novell NetWare operating systems.

1. Insert the CD into the CD-ROM drive and restart the server.
2. When the CD menu is displayed, double-click the **ACU** icon.
3. Configure your array (see the "Typical Manual Configuration Procedures" section for details if you do not want to use the wizard).
4. Remove the CD and restart the server to activate the new settings.

Running ACU while Online

You can run ACU online with the Windows NT or Windows 2000 operating system.

1. Insert the CD into the CD-ROM drive of the server and follow the on-screen instructions to download the utility.
2. When installation is complete, click **Start,** and then select **Compaq System Tools.**
3. Double-click **ACU**.

ACU Screen Descriptions

NOTE: The screenshots shown with these descriptions are merely examples. The exact appearance of your screen depends on the controller and hard dnves that you use. For example, the number of ports on the controller and the RAID levels available may be different in your case.

Main Configuration Screen

This **ACU Main Configuration** screen is the first to be displayed after the configuration wizard has finished or been bypassed.

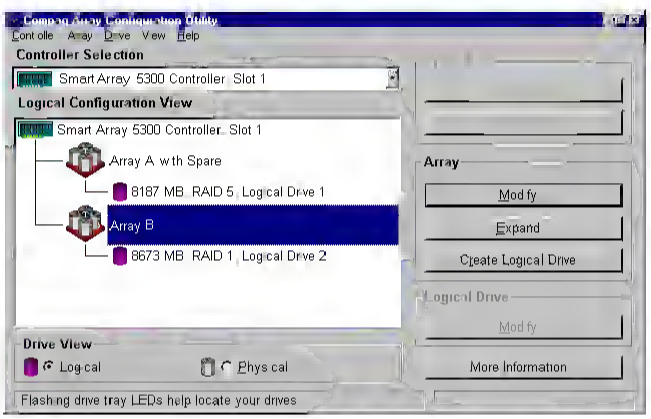


Figure 7-2: Example of ACU Main Configuration screen

This screen contains the following regions:

- Menu bar
- **Controller Selection** box
- **Logical Configuration View** window
- **Drive View** box
- **Controller** box
- **Array** box
- **Logical Drive** box

Menu Bar

The menu bar at the top of the **ACU Main Configuration** screen contains the following drop-down menus:

- **Controller**—Allows you to select a controller, refresh the screen, save or clear a configuration, create an array, or exit the program. Other menu items give access to settings, advanced features, information, and the configuration wizard.
- **Array**—Allows you to delete or modify an array, or to expand array capacity, create logical drives, and view array information.
- **Drive**—Allows you to delete or change logical drives and to view drive information.
- **View**—Allows you to switch between **Physical Configuration View** and **Logical Configuration View.**
- **Help**—Allows you to access online help.

Controller Selection Box

This box provides a drop-down list of the controllers installed in the system. When you select a controller, details of the drives and arrays that are connected to the controller are shown in the **Configuration View** window.

Figure 7-3: Controller Selection box

Physical/Logical Configuration View Window

The **Physical/Logical Configuration View** window shows the drives and arrays that are connected to the selected controller. The **Drive View** radio buttons below the **Configuration View** window let you switch between the physical and logical configuration views.

Figure 7-4 shows a typical physical configuration view, and Figure 7-2 shows a typical logical configuration view.

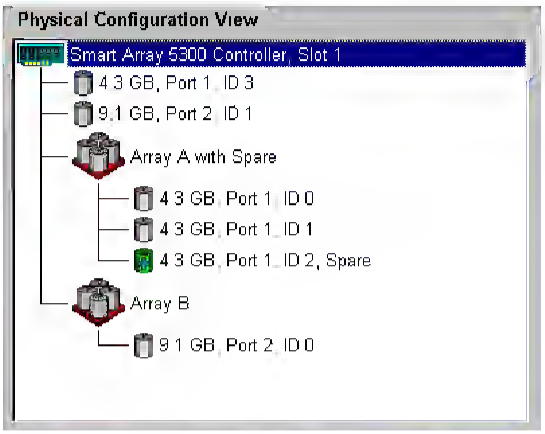

Physical Configuration View
Smart Array 5300 Controller, Slot 1
4.3 GB, Port 1, ID 3
9.1 GB, Port 2, ID 1
Array A with Spare
4.3 GB, Port 1, ID 0
4.3 GB, Port 1, ID 1
4.3 GB, Port 1, ID 2, Spare
Array B
9.1 GB, Port 2, ID 0

Figure 7-4: Physical Configuration View window

NOTE: Selecting any item in the **Configuration View** window will cause the corresponding hard drive tray LEDs to blink. This feature is useful for identifying all physical drives in an array or logical drive, all drives on a controller, or a specific physical drive.

Drive View Box

Use the radio buttons in this box to display a logical or physical configuration view in the **Configuration View** window.

Figure 7-5: Drive View box

Controller Box

The buttons in the **Controller** box are activated when you select a controller in the **Controller Selection** box.

Figure 7-6: Controller box

Click one of these buttons to display the **Controller Settings** screen or the **Create Drive Array** screen.

Array Box

The buttons in the **Array** box are activated when you select an array in the **Configuration View** window.

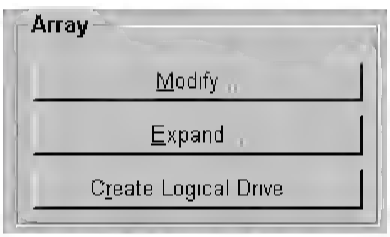


Figure 7-7: Array box

Click one of these buttons to display the **Modify Drive Array** screen, the **Expand Array** screen, or the **Create Logical Drive** screen.

Logical Drive Box

The buttons in the **Logical Drive** box are activated when you select a logical drive in the **Configuration View** window.

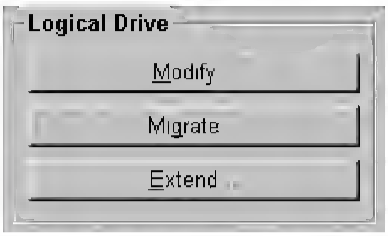


Figure 7-8: Logical Drive box

Click one of these buttons to display the **Modify Logical Drive** screen, the **Migrate Logical Drive** screen, or the **Extend Logical Drive** screen.

More Information Button

Click **More Information** in the bottom right of the **ACU Main Configuration** screen to get a detailed description of the item that is selected in the **Configuration View** window.

Secondary Screens

Controller Settings Screen

To display this screen, click **Settings** in the **Controller** box (Figure 7-6) on the **ACU Main Configuration** screen.

This screen allows you to set the rebuild priority, expand priority, and accelerator read/write ratio.

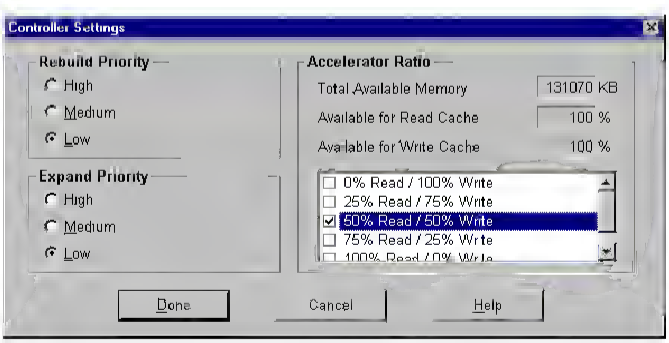


Figure 7-9: Controller Settings screen

The settings that you use for **Rebuild Priority** and **Expand Priority** will not affect the performance of an idle system. However, they will affect performance on a busy system:

- On the **High** settings, the controller will give preference to the rebuild or expansion process over normal I/O operations.
- On the **Low** settings, the controller will rebuild or expand only when the controller is idle. However, this setting leaves the array vulnerable to drive failure for a longer time than the **High** setting.

The **Accelerator Ratio** setting determines the amount of memory allocated to the read and write caches. Some applications may perform better with a larger write cache; others may perform better with a larger read cache. If your controller does not have a battery backed array accelerator, only read cache will be available (the ratio will always be 100% Read / 0% Write).

NOTE: If you optimize the **Accelerator Ratio** setting, you may also want to change the **Stripe Size** setting. See the "Create Logical Drive Screen" section and Table 7-2 and Table 7-3 for details.

Create Drive Array Screen

To display this screen, click **Create Array** in the **Controller** box (Figure 7-6) on the **ACU Main Configuration** screen. The left panel of the **Create Drive Array** screen shows all drives that are attached to the controller that was selected on the **ACU Main Configuration** screen.

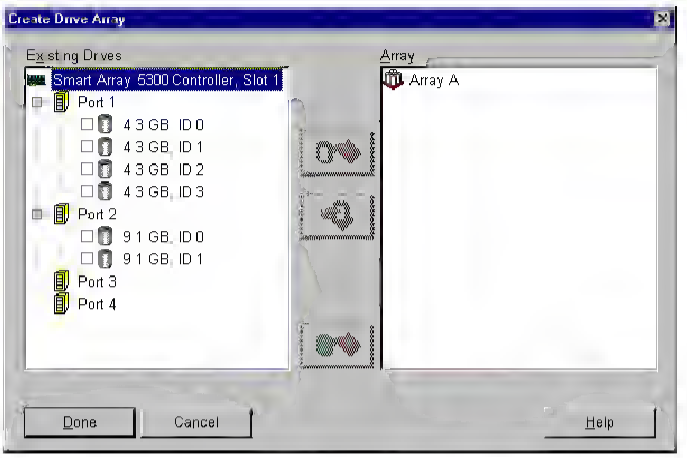


Figure 7-10: Create Drive Array screen

The three buttons in the middle of this screen are:

- **Assign Drive To Array**
- **Remove Drive From Array**
- **Assign Spare To Array**

Modify Drive Array Screen

To display this screen, click **Modify** in the **Array** box on the **ACU Main Configuration** screen. This screen resembles the **Create Drive Array** screen (Figure 7-10), and allows you to change the configuration of your array.

Expand Array Screen

To display this screen, click **Expand** in the **Array** box on the **ACU Main Configuration** screen.

The **Expand Array** screen resembles the **Create Drive Array** screen (Figure 7-10). It allows you to add more hard drives to an array that has already been configured. The extra capacity can be used to build another logical drive on the array, or to extend a logical drive that already exists on the array.

Create Logical Drive Screen

To display this screen, click **Create Logical Drive** in the **Array** box (Figure 7-7) on the **ACU Main Configuration** screen.

This screen allows you to select the fault-tolerance method, enable the array accelerator (if present), and set the stripe size and logical drive size on a new logical drive.

CAUTION: Do not use this screen to modify a pre-existing logical drive, since this method does **not** preserve user data. Instead, to change the RAID level and stripe size on a logical drive that **already contains user data**, click **Migrate** to reach the **Migrate RAID/Stripe Size** screen (Figure 7-13).

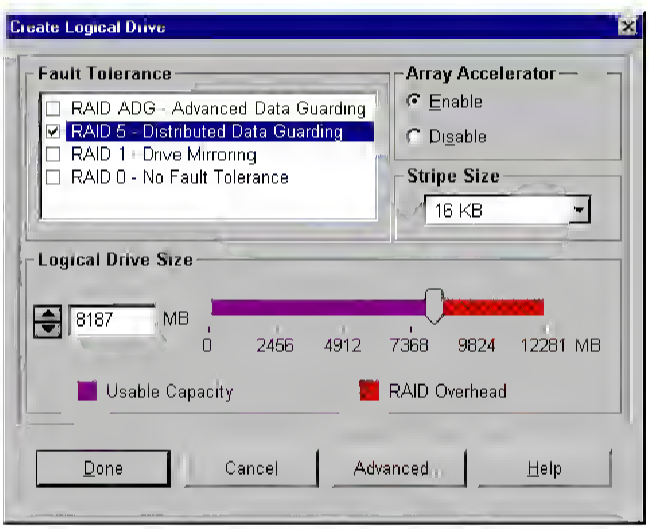


Figure 7-11: Create Logical Drive screen

Three features on this screen merit further description:

- **Stripe Size** box
- **Logical Drive Size** box
- **Advanced** button

The **Stripe Size** box has a drop-down menu that lets you select the width of a data stripe. (This width corresponds to the size of a data block on each hard drive in the logical volume, as described in Appendix D).

Each RAID level supports several stripe widths (Table 7-2); the default stripe size initially displayed by ACU is chosen for optimum performance under the most common operating conditions. Table 7-3 suggests how to optimize the stripe width for different types of application.

Table 7-2: Supported Stripe Sizes for a Given RAID Level

Fault Tolerance Level	Supported Stripe Sizes (KB)	Default (KB)
RAID 0	8, 16, 32, 64, 128, 256	128
RAID 1 or 1+0	8, 16, 32, 64, 128, 256	128
RAID 5	8, 16, 32, 64	16

Table 7-3: Optimum Stripe Size for a Given Application

Type of Server Application	Suggested Stripe Size Change
Mixed read/write	Accept the default value
Mainly sequential read (such as audio/video applications)	Use larger stripe sizes for best performance
Mainly write (such as image manipulation applications)	Use smaller stripes for RAID 5 Use larger stripes for RAID 0, RAID 1+0, RAID 1

The **Logical Drive Size** box shows how much drive capacity is available on the selected logical drive when using the chosen RAID level. The left side of the slider scale shows how much drive capacity is available for data storage, while the right side indicates how much capacity is required for storing parity or mirrored information. (RAID overhead is not needed for RAID 0.)

The default logical drive size first shown in this box is the maximum available for your drive array. To create more than one logical drive on the array, reduce the logical drive size by typing a smaller number in the scroll box. ACU allows you to create up to 32 logical drives per array.

Click **Advanced** to display the **Advanced Features** screen, where you can enable or disable the maximum boot size for a logical drive. The default boot size is 32 sectors (16 kbytes) per track, and the maximum boot size is 63 sectors per track.

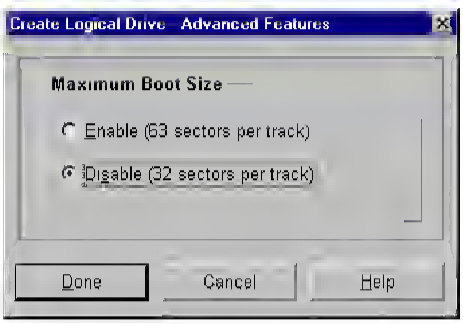


Figure 7-12: Advanced Features screen

Some operating systems need to use the maximum boot size to be able to create large boot partitions. For example, enabling the maximum boot size on a logical drive in the Windows NT 4.0 operating system allows you to create a bootable partition with a maximum size of 8 GB.

NOTE: Enabling the maximum boot size may decrease performance of the logical drive.

Modify Logical Drive Screen

To display this screen, click **Modify** in the **Logical Drive** box (Figure 7-8) on the **ACU Main Configuration** screen. This screen resembles the **Create Logical Drive** screen (Figure 7-11), and lets you change the parameters of an existing logical drive while online, without causing data loss.

Migrate RAID/Stripe Size Screen

To display this screen, click **Migrate** in the **Logical Drive** box (Figure 7-8) on the **ACU Main Configuration** screen. It allows you to change the stripe width (block size) or RAID level of an existing logical drive while online, without causing data loss.

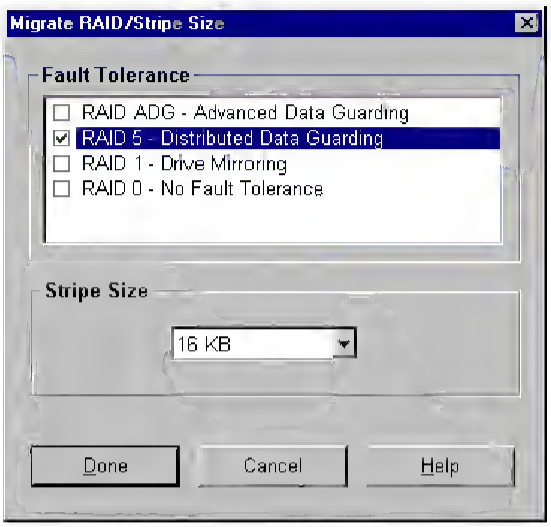


Figure 7-13: Migrate RAID/Stripe Size screen

Extend Logical Drive Screen

To display this screen, click **Extend** in the **Logical Drive** box (Figure 7-8) on the **ACU Main Configuration** screen. This screen allows you to increase the capacity of a logical drive while the system is online, without disruption of data.

IMPORTANT: Not all operating systems support online capacity extension. See the section "Extending Logical Drive Capacity" for more information.

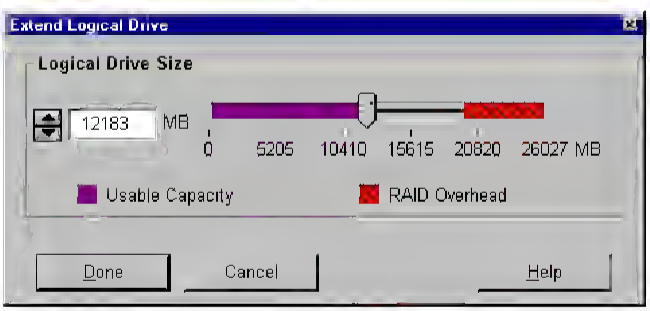


Figure 7-14: Extend Logical Drive screen

Typical Manual Configuration Procedures in ACU

When you launch ACU to configure a new array, a configuration wizard opens to allow rapid, automatic array configuration. However, you can bypass the wizard and manually:

- Create a new array
- Expand the capacity of an array
- Extend the capacity of a logical drive
- Migrate to a different RAID level or stripe size

Creating a New Array

There are three stages in the procedure for manually creating a new array:

1. Configure the controller settings.
2. Assign physical drives of the same size to an array.
3. Create one or more logical drives on the array.

For this example, assume that you have four 4.3-GB drives and two 9.1-GB drives connected to your controller. You want to make two arrays:

- Array A: three 4.3-GB drives with the fourth 4.3-GB drive used as a spare. This array is to be configured with RAID 5 fault tolerance.
- Array B: two 9.1-GB drives in a RAID 1 fault-tolerance configuration.

Configuring the Controller Settings

1. On the ACU **Main Configuration** screen, select the controller to be used from the drop-down list in the **Controller Selection** box. (Alternatively, click **Controller** on the menu bar, and then click **Select.**)
2. Click **Controller Settings**.

   The **Controller Settings** screen is displayed (Figure 7-9).
3. Select the rebuild priority, expand priority, and accelerator ratio.
4. Click **Done** to return to the ACU **Main Configuration** screen.

Assigning Physical Drives of the Same Size to an Array

1. Click **Create Array** in the **Controller** box.

   The **Create Drive Array** screen is displayed (Figure 7-10).

2. Select the drives that you want to build the array with from the drives that are shown in the left panel.

   IMPORTANT: Do not assign a group of physical drives to the same array unless they are of the same capacity. If the drives have different capacities, the excess capacity of the larger drives cannot be used by the array and is wasted.

   For this example, select the three drives on Port 1 with SCSI IDs 0, 1, and 2.

3. Click **Assign Drive(s) to Array** (Figure 7-19) in the middle of the screen.

   NOTE: The probability that an array will experience a drive failure increases with the number of drives in the array. Compaq recommends that no more than 14 drives be used per array in RAID 5 configurations.

4. Select the drive at Port 1: SCSI ID 3 and click **Assign Spare to Array** in the middle of the screen.

   NOTE: You can assign the same spare drive to several arrays. In such a case, verify that the capacity of the spare is enough for each array. (Spare drives must have a capacity no less than that of other drives in the same array.)

The **Create Drive Array** screen now looks like Figure 7-15.

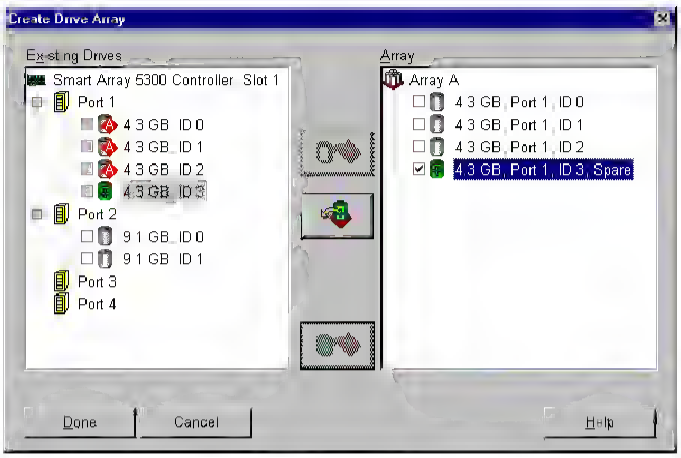


Figure 7-15: Example Array A with Spare

5. Click **Done** to return to the **ACU Main Configuration** screen.

The **Logical Configuration View** window now looks like Figure 7-16.

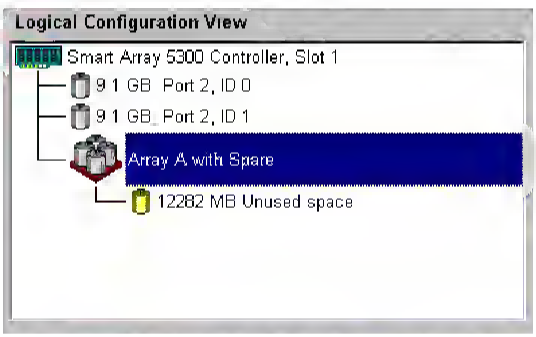

Logical Configuration View
Smart Array 5300 Controller, Slot 1
9.1 GB, Port 2, ID 0
9.1 GB, Port 2, ID 1
Array A with Spare
12282 MB Unused space

Figure 7-16: Logical Configuration View of Example Array

6. Select the controller icon, and then click **Create Array** to create Array B.
7. Repeat the previous steps to assign both 9.1-GB drives to Array B.
8. Click **Done** to return to the **ACU Main Configuration** screen.

In this example, each array was created using drives from the same SCSI port. You can get better performance by installing the correct capacity drives in other ports before running the ACU, and then selecting drives from more than one port to build the array.

Creating One or More Logical Drives on the Array

1. Select **Array A** or **Unused Space** under Array A in the **Logical Configuration View** window (Figure 7-16).
2. Click **Create Logical Drive** in the **Array** box.
3. On the **Create Logical Drive** screen (Figure 7-11), select **RAID 5**.
4. Click **Enable Array Accelerator**, if it is active.
5. Change the stripe size, if desired (and if possible for your controller model).
6. The default values in the **Logical Drive Size** box will create a single logical drive on the array. For this example, accept the default values.
7. Click **Done** to return to the **ACU Main Configuration** screen.
8. Save the new settings by clicking **Controller** on the menu bar and selecting **Save Configuration**.
9. Create a logical drive on Array B by selecting **Array B** or **Unused Space** under Array B in the **Logical Configuration View** window and following the previous steps. This time, select RAID 1 as the fault tolerance method. Save the configuration as before.

The **ACU Main Configuration** screen now looks like Figure 7-17.

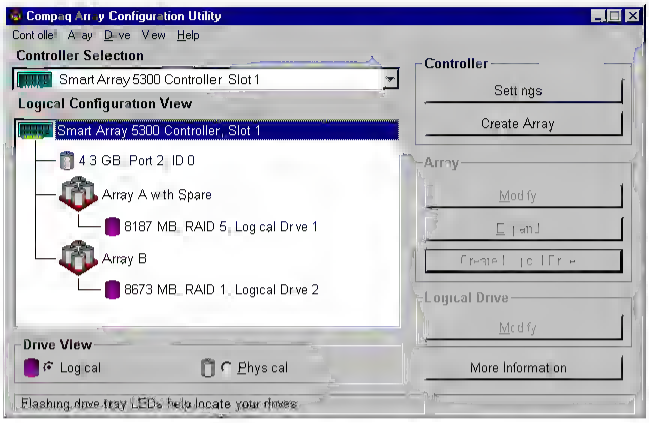


Figure 7-17: Example array – Logical Configuration View window, two arrays

NOTE: The capacity shown for each logical drive is the free capacity available for data storage. This value excludes the amount used for fault tolerance.

Expanding Array Capacity

Array capacity expansion is the addition of storage capacity to a pre-existing array. The capacity of logical drives on the array does not change, and existing data is not changed.

During capacity expansion, ACU automatically redistributes existing logical drives across all of the physical drives in the expanded array. If the array being expanded has more than one logical drive, data is redistributed one logical drive at a time. Newly created logical drives are not available until capacity expansion has finished.

CAUTION: Do not exchange the controller or array accelerator board during array capacity expansion. Interrupting expansion in this way causes irretrievable data loss.

NOTE: The expansion process takes about 15 minutes per gigabyte. A logical drive is unavailable for any other process while it is undergoing an expansion, and no other logical drive in the system can be expanded, extended, or migrated during this time.

There are three stages in the procedure for expanding an array:

1. Back up all data on the array. Although array expansion is unlikely to cause data loss, observing this precaution will provide additional data protection.
2. Install the new physical drives.

   IMPORTANT: Do not assign a group of physical drives to the same array unless they are of the same capacity. If the drives have different capacities, the excess capacity of the larger drives cannot be used by the array and is wasted.

3. Assign the new physical drives to an existing array. When the expansion process is complete, the extra capacity can be used to increase the size of an existing logical drive (see the "Extending Logical Drive Capacity" section) or to create a new logical drive.

For example, consider a controller with these two arrays:

- Array A—three 4.3-GB drives in a RAID 5 configuration, no spare.
- Array B—two 9.1-GB drives in a RAID 1 configuration, no spare.

Now you install a 4.3-GB drive, and want to expand Array A to include this new drive. This scenario is represented in Figure 7-18.

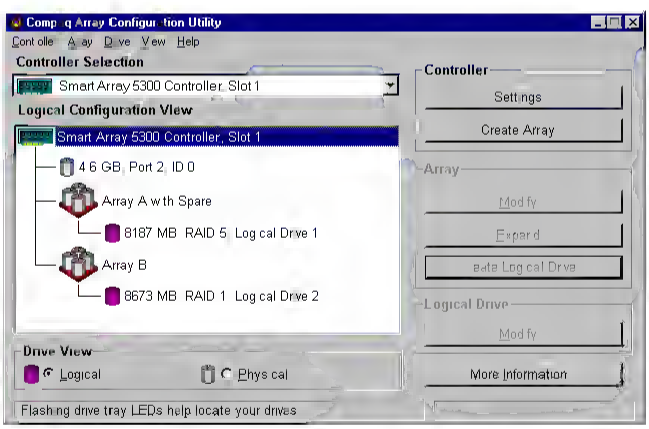


Figure 7-18: Array expansion example

To expand Array A and create a second logical drive on this array:

1. Select Array A in the **Logical Configuration View** window.

2. Click **Expand** in the **Array** box.
3. In the left-hand panel of the **Expand Array A** dialog box, select the unassigned 4.3-GB drive.
4. Click **Assign Drive to Array** in the middle of the screen.

Figure 7-19: Assign Drive to Array button

5. Click **Next** at the bottom of the screen. The screen shown in Figure 7-20 is displayed.

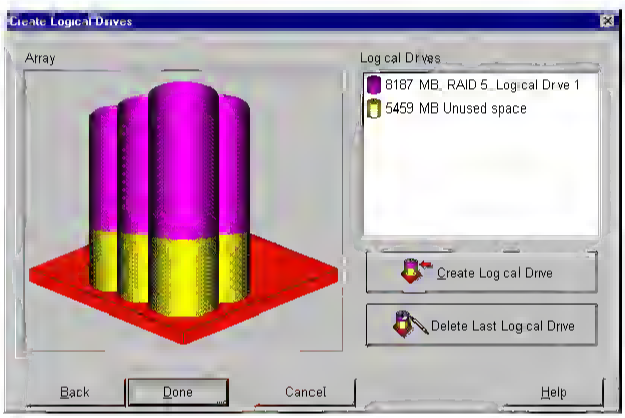


Figure 7-20: Expansion Wizard – Create Logical Drives screen

6. Click **Create Logical Drive**.
7. Set the fault tolerance, stripe size, array accelerator, and size for the second logical drive that you want to create on Array A.
8. Click **Done** to return to the **Create Logical Drives** screen.
9. Click **Done** again to return to the **ACU Main Configuration** screen.
10. On the menu bar, select **Controller, Save Configuration.** The settings for the second logical drive are saved and the capacity expansion process begins.

NOTE: The second logical drive is not accessible until the capacity expansion process on Logical Drive 1 is complete. Also, Logical Drive 1 is unavailable for any other process while it is undergoing an expansion, and no other logical drive in the system can be expanded, extended, or migrated during this time.

Extending Logical Drive Capacity

Logical drive capacity extension is the addition of storage capacity to an existing logical drive. For logical drive extension to be possible, sufficient free capacity must exist on the array. If necessary, create free capacity by deleting existing logical drives on the array or by performing an array expansion (see "Expanding Array Capacity").

Windows NT 4.0 and NetWare 5.x operating system support **online** logical drive capacity extension. Some operating systems also support **offline** capacity extension, which is carried out by backing up all data, reconfiguring the array, and restoring the data. Before extending logical drives, check the operating system documentation for current information, or contact your operating system vendor.

NOTE: The extension process takes about 15 minutes per gigabyte. A logical drive is unavailable for any other process while it is undergoing an extension, and no other logical drive in the system can be expanded, extended, or migrated during this time.

To extend the capacity of a logical drive:

1. Back up all data on the array. Although array expansion is unlikely to cause data loss, observing this precaution will provide additional data protection.
2. Select the logical drive in the **Logical Configuration View** window.
3. Click **Extend** in the **Logical Drive** box.

   The **Extend Logical Drive** screen displays the current capacity and overhead of the selected logical drive. The unshaded region on the slider scale shows the free capacity on the array that is available for extension.
4. Move the slider control to increase the size of the logical drive.

   NOTE: You cannot reduce the size of the logical drive from this screen.
5. Click **Done** to return to the **ACU Main Configuration** screen.

6. To save the logical drive settings, click **Controller** on the menu bar and select **Save Configuration**.

   A progress bar in the lower right-hand corner of the screen shows the status of the extension process.

7. Make the extra capacity of the logical drive available to the operating system by one of the following methods:

   — Create a new partition in the logical drive by using the operating system partitioning software.

   — Increase the size of an existing partition by using the operating system partitioning software or third-party partitioning tools.

Migrating RAID Level or Stripe Size

NOTE: Before migrating the stripe size, check that the available memory on the array accelerator is no smaller than the lowest common multiple of the total stripe sizes of the two different configurations.

For example, consider the change from an 11-drive RAID 5 logical volume to a 14-drive RAID 1+0 logical volume. If each configuration uses the corresponding default stripe width, the block size changes from 16 kbytes per stripe to 128 kbytes per stripe.

- A full stripe in the RAID 5 configuration contains 160 kbytes (ten of the drives contain user data; one drive contains parity data).
- A full stripe in the RAID 1+0 configuration contains 896 kbytes.

The lowest common multiple of the two stripe sizes is 4480 kbytes, and this figure represents the minimum amount of memory that must be available on the array accelerator.

To migrate to a different RAID level or stripe size:

1. Back up all data on the logical drive. Although migration is unlikely to cause data loss, observing this precaution provides extra security. The backup data may also be needed if the number of sectors needs to be increased (this fact will be determined in step 8).
2. Verify that the array accelerator batteries (if present) are fully charged.

   NOTE: The migration process takes about 15 minutes per gigabyte. A logical drive is unavailable for any other process while it is undergoing migration, and no other logical drive in the system can be expanded, extended, or migrated during this time.

3. If your controller has a battery backed write cache, check the **Controller Settings** screen to confirm that the write cache is enabled.
4. Select the logical drive in the **Logical Configuration View** window.
5. Click **Migrate** in the **Logical Drive** box.
6. Change the RAID level by selecting the appropriate check box.
7. Change the stripe size (Table 7-3 gives the optimum stripe size for specific situations).
8. Click **Done** to return to the **ACU Main Configuration** screen.

   If you get a message stating that the number of sectors needs to be increased:

   a. Delete the old logical volume.

   b. Reconfigure the array as a new logical volume with the new fault-tolerance method and stripe size that you had selected.

   c. Copy the backed-up data (from step 1) onto the new logical volume.
9. To save the new settings, click **Controller** on the menu bar and select **Save Configuration**.

Using CPQONLIN

The NetWare Online Array Configuration Utility (CPQONLIN) lets you configure your drive arrays without shutting down your server. It also indicates when a drive attached to the array controller has failed, is undergoing expansion, or is waiting (queued) for expansion or rebuild.

To install CPQONLIN:

1. Load CPQRAID.HAM from the SmartStart and Support Software CD or the Controller Support Software CD and diskettes. (Detailed instructions are given in the README file on the CD.)
2. Load CPQONLIN.NLM from the same source.
3. Open CPQONLIN.NLM and follow the on-screen instructions.

Running CPQONLIN

1. Enter `cpqonlin` at the console prompt.
2. Use the arrow keys to highlight **Array Configuration Utility**, and then press the **Enter** key.
3. From the list of controllers that is presented, select the one that you want to configure.
   - If no logical drives are configured for the controller, the auto-configuration wizard screen (see Figure 7-21) is displayed.
   - If logical drives are present on the controller, the manual configuration screen (see Figure 7-22) is displayed.

   Press the **F1** key for online help at any time on either screen.

Automatic Configuration

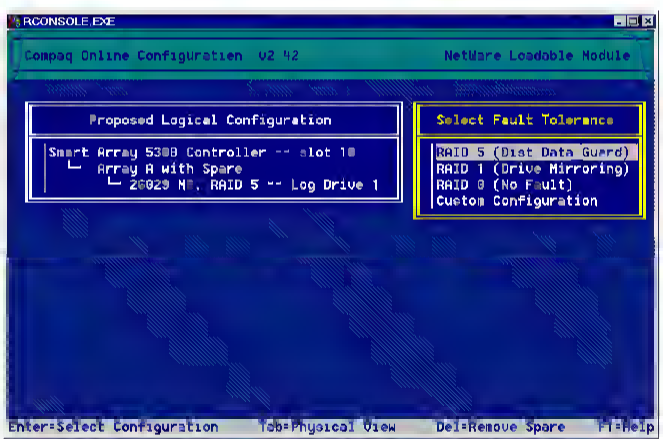


Figure 7-21: CPQONLIN auto-configuration wizard

1. If the proposed logical configuration shown on the wizard screen is acceptable, highlight the fault tolerance level that you want for the logical drive and press the **Enter** key. Otherwise, select **Custom Configuration** and continue the procedure as described in the "Manual Configuration" section.
2. Press the **Esc** key to save the changes and return to the controller selection screen.

3. Restart the system to apply the changes.

NOTE: Raw logical drives are invisible to the operating system. To make the new logical drives available for data storage, format the logical drive using the instructions given in your operating system documentation.

Manual Configuration

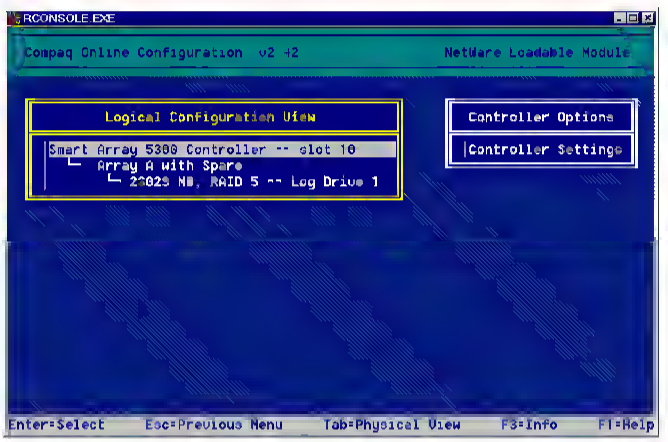


Figure 7-22: Main manual configuration screen

Highlight the controller, array, or logical drive that you want to configure, and then press the **Enter** key. The menu options for that item are shown in the panel on the right-hand side of the screen. Table 7-4 lists the menu options for each item in the **Logical Configuration View** panel. If an option is not applicable in any particular case, it is not displayed in the panel.

Table 7-4: Menu Options in CPQONLIN

Controller Options Menu		
Controller Settings	**Rebuild Priority**	
	Expand Priority	
	Accelerator Ratio	
Create New Array	**Create Array**	Assign Drive
		Assign Array
		Remove Drive
		Accept Changes
	Physical Drives	(Panel shows spare drives and unassigned hard drives attached to the controller)
	New Array	(Panel shows physical view of new array)
Array Options Menu		
Expand Array	**Expand Array**	Assign Drive
		Accept Changes
	Physical Drives	(Panel shows spare drives and unassigned hard drives attached to the controller)
	New Array	(Panel shows physical view of new array)
Assign Spare	**Assign Spare**	Assign Drive
		Accept Changes
	Physical Drives	(Panel shows spare drives and unassigned hard drives attached to the controller)
	New Array	(Panel shows physical view of new array)
Delete Entire Array		
Logical Drive Options Menu		
Drive Settings	**Fault Tolerance**	
	Stripe Size	

Typical Manual Configuration Procedures in CPQONLIN

This section describes typical manual configuration procedures in more detail.

Creating a Custom Configuration for a New Array

1. In the **Logical Configuration View** panel, highlight the controller that you want to configure and then press the **Enter** key.
2. Select **Create New Array** from the **Controller Options** menu, and then press the **Enter** key.

   The screen now displays three panels: **Create Array, Physical Drives,** and **New Array.**
3. Select **Assign Drive** from the **Create Array** menu, and then press the **Enter** key.

   The highlight automatically moves to the **Physical Drives** panel.
4. Select a drive and then press the **Enter** key.

   IMPORTANT: Do not assign a group of physical drives to the same array unless they are of the same capacity. If the drives have different capacities, the excess capacity of the larger drives cannot be used by the array and is wasted.

   The **New Array** panel lists the added drive, and the highlight automatically returns to the **Create Array** panel.
5. Repeat steps 3 and 4 until you have finished assigning drives to the array.

   NOTE: You can add a spare drive to the array only when all data storage drives have been assigned.
6. Select **Accept Changes** and press the **Enter** key.

   CPQONLIN returns to the **Main Manual Configuration** screen.

Adding a Spare Drive

To add a spare drive to an array, the array controller must have an attached drive that is either unassigned or is assigned as a spare to another array. You can assign a spare to as many arrays as you want, or you can assign a separate spare to each array. When you select **Assign Spare**, only drives that qualify will be displayed (for example, drives with too small a capacity will not be listed). If a drive that you expect to see is not listed, press the **Tab** key to switch to the physical drive view and check the capacity of the drive.

1. In the **Logical Configuration View** panel, select the array that needs a spare, and then press the **Enter** key.
2. Select **Assign Spare** from the **Array Options** menu, and then press the **Enter** key.
3. Select the drive that you want as the spare, and then press the **Enter** key.
4. Press the **Esc** key to accept the new configuration and return to the **Main Manual Configuration** screen.

Configuring the New Logical Drive

1. In the **Logical Configuration View** panel, select the new logical drive that you want to configure, and then press **Enter.**
2. Select **Fault Tolerance** in the **Logical Drive Options** menu, and then press the **Enter** key.
3. Select the RAID level that you want, and then press the **Enter** key.
4. Select **Stripe Size** and then press the **Enter** key.
5. Select the stripe size that you want, and then press the **Enter** key.
6. Press the **Esc** key to accept the settings, and return to the **Main Manual Configuration** screen.

Configuring the Controller Settings

The **Controller Settings** menu option allows you to choose the drive rebuild priority, expansion priority, and accelerator ratio for all arrays on the controller.

- With a **low** priority setting, a rebuild or expansion takes place only when the array controller is not busy handling normal I/O requests. This setting has minimal effect on normal I/O operations. However, there is an increased risk that data will be lost if another physical drive fails while the rebuild is in progress.
- With a **high** priority setting, the rebuild or expansion occurs at the expense of normal I/O operations. Although performance is affected, this setting provides better data protection because the array is vulnerable to additional drive failures for a shorter time.

NOTE: Logical drives can be rebuilt only if they are configured for fault tolerance (RAID 1+0, 5, or ADG). Drive rebuild begins automatically after you have replaced a failed physical drive in the array.

The accelerator read/write ratio determines the amount of memory allocated to the read and write caches on the array accelerator. Different applications have different optimum settings. Some controllers (especially those without battery backed write cache) do not allow this ratio to be changed.

1. In the **Logical Configuration View** panel, select the controller that you want to configure, and then press the **Enter** key.
2. Select **Controller Settings** from the **Controller Options** panel, and then press the **Enter** key.

   The **Controller Settings** screen is displayed.

RCONSOLE.EXE
Compaq Online Configuration v2.42
NetWare Loadable Module
Compaq Smart Array 5300 controller in PCI slot 10
Rebuild Priority : High
Expand Priority : Low
Accelerator Ratio : Read 50% - Write 50%
Press Esc to save changes or exit
F1=Help

Figure 7-23: Controller Settings screen

3. Alter the settings on this screen to suit your needs.
4. Press the **Esc** key to save the new configuration.
5. Exit CPQONLIN, and then restart the system to apply the changes.

Expanding an Array

Performance may be degraded slightly during array expansion, depending on the **Expand Priority** setting. To minimize any effect, expand the array during periods of low server use.

NOTE: The expansion process takes about 15 minutes per gigabyte. The controller is not able to expand or migrate any other logical drive during this time. Instead, further requests for expansion or migration are queued.

1. Back up all data on the logical drive. Although array expansion is unlikely to cause data loss, observing this precaution provides extra security.
2. Verify that the array accelerator batteries (if present) are fully charged.
3. In the **Logical Configuration View** panel, select the array that you want to expand and then press the **Enter** key.
4. Select **Expand** and then press the **Enter** key.
5. Select the hard drive that you want to add to the array, and then press the **Enter** key.

   IMPORTANT: Do not assign a group of physical drives to the same array unless they are of the same capacity. If the drives have different capacities, the excess capacity of the larger drives cannot be used by the array and is wasted.

6. Repeat step 5 until you have finished adding drives.
7. Select **Accept Changes** and then press the **Enter** key.
8. Press the **Esc** key to begin the array expansion.

   You can see the progress of the expansion at any time by pressing the **F3** key and then scrolling to the progress bar near the bottom of the screen.

Migrating RAID Level or Stripe Size

Performance may be degraded slightly during migration, depending on the **Expand** (or **Rebuild**) **Priority** setting. To minimize any effect, migrate during periods of low server use.

NOTE: The migration process takes about 15 minutes per gigabyte. The controller is not able to expand or migrate any other logical drive during this time. Instead, further requests for expansion or migration will be queued.

1. Back up all data on the logical drive. Although migration is unlikely to cause data loss, observing this precaution provides extra security.
2. Verify that the array accelerator batteries (if present) are fully charged.
3. In the **Logical Configuration View** panel, select the logical drive that you want to migrate, and then press the **Enter** key.
4. Select **Drive Settings** and then press the **Enter** key.
5. Change the RAID level or stripe size shown on this screen.
6. Press the **Esc** key to accept the changes and begin migration.

   You can check the progress of the migration at any time by pressing the **F3** key and then scrolling to the progress bar near the bottom of the screen.

8

Installing the Device Drivers

The drivers for the Smart Array 5i Plus Controller are located on the Smart Array Controller Support Software CD and on the SmartStart and Support Software CD. Updates are posted to the Compaq website, www.compaq.com.

Using the Smart Array Controller Support Software CD

Instructions for installing the drivers from the Smart Array controller Support Software CD are given in the leaflet provided with the CD. Note that the exact procedure depends on whether the server is new, or already contains the operating system and user data.

Using the SmartStart and Support Software CD

If you are setting up a **new** server, the Smart Array Controller drivers are installed and configured at the same time that you install the operating system. Refer to the documentation provided with the CD for the operating system installation instructions.

If you are adding the controller to an **existing system,** you must create Compaq Support Paq diskettes (CSPs) for the operating system that you use. These diskettes contain the operating system software, drivers, and support documentation.

To create CSPs:

1. Insert the SmartStart and Support Software CD into the CD-ROM drive tray of a server with a bootable CD-ROM drive. The server does not need to be the one in which you are going to install the controller.
2. Restart the server.
3. On the **Compaq System Utilities** screen, select **Create Support Software**.
4. On the **Diskette Builder** screen, select **Create Support Software From CD Only.**
5. Scroll down the list and select the support software for the operating system that you are using.
6. Follow the on-screen instructions to create the diskettes. Depending on your operating system, you will need to use up to six blank diskettes.

Detailed instructions for installing the device drivers are given in the README files on the CSPs.

Updating the Compaq Insight Manager Agents

If you are installing the controller as additional storage, you may now update the Compaq Insight Manager agents if new versions are available. Refer to the documentation that is included with Compaq Insight Manager for the correct procedure to update the agents.

You can obtain the Compaq Insight Manager Agents from your local Compaq reseller or Compaq authorized service provider. The latest versions of Compaq Insight Manager and Management Agents are also available for download at www.compaq.com/manage.

If the new agents do not function correctly, you may also need to update Compaq Insight Manager.

A

Regulatory Compliance Notices

Regulatory Compliance Identification Numbers

For the purpose of regulatory compliance certifications and identification, your product has been assigned a unique Compaq series number. The series number can be found on the product nameplate label, along with all required approval markings and information. When requesting compliance information for this product, always refer to this series number. The series number should not be confused with the marketing name or model number of the product.

Federal Communications Commission Notice

Part 15 of the Federal Communications Commission (FCC) Rules and Regulations has established Radio Frequency (RF) emission limits to provide an interference-free radio frequency spectrum. Many electronic devices, including computers, generate RF energy incidental to their intended function and are, therefore, covered by these rules. These rules place computers and related peripheral devices into two classes, A and B, depending upon their intended installation. Class A devices are those that may reasonably be expected to be installed in a business or commercial environment. Class B devices are those that may reasonably be expected to be installed in a residential environment (for example, personal computers). The FCC requires devices in both classes to bear a label indicating the interference potential of the device as well as additional operating instructions for the user.

The rating label on the device shows the classification (A or B) of the equipment. Class B devices have an FCC logo or FCC ID on the label. Class A devices do not have an FCC logo or FCC ID on the label. After the Class of the device is determined, refer to the corresponding statement in the following sections.

Class A Equipment

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at personal expense.

Class B Equipment

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit that is different from that to which the receiver is connected.
- Consult the dealer or an experienced radio or television technician for help.

Declaration of Conformity for Products Marked with the FCC Logo, United States Only

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

For questions regarding your product, contact us by mail or telephone:

- Compaq Computer Corporation
  P. O. Box 692000, Mail Stop 530113
  Houston, Texas 77269-2000
- 1-800-652-6672 (1-800-OK COMPAQ) (For continuous quality improvement, calls may be recorded or monitored.)

For questions regarding this FCC declaration, contact us by mail or telephone:

- Compaq Computer Corporation
  P. O. Box 692000, Mail Stop 510101
  Houston, Texas 77269-2000
- 1-281-514-3333

To identify this product, refer to the part, series, or model number found on the product.

Modifications

The FCC requires the user to be notified that any changes or modifications made to this device that are not expressly approved by Compaq Computer Corporation may void the user's authority to operate the equipment.

Cables

Connections to this device must be made with shielded cables with metallic RFI/EMI connector hoods in order to maintain compliance with FCC Rules and Regulations.

Canadian Notice (Avis Canadien)

Class A Equipment

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Class B Equipment

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Mouse Compliance Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation

European Union Notice

Products with the CE Marking comply with both the EMC Directive (89/336/EEC) and the Low Voltage Directive (73/23/EEC) issued by the Commission of the European Community.

Compliance with these directives implies conformity to the following European Norms (the equivalent international standards are in parenthesis):

- EN55022 (CISPR 22) – Electromagnetic Interference
- EN55024 (IEC61000-4-2, 3, 4, 5, 6, 8, 11) – Electromagnetic Immunity
- EN61000-3-2 (IEC61000-3-2) – Power Line Harmonics
- EN61000-3-3 (IEC61000-3-3) – Power Line Flicker
- EN60950 (IEC950) – Product Safety

Japanese Notice

ご使用になっている装置にVCCIマークが付いていましたら、次の説明文をお読み下さい。

この装置は、情報処理装置等電波障害自主規制協議会（VCCI）の基準に基づくクラスB情報技術装置です。この装置は、家庭環境で使用することを目的としていますが、この装置がラジオやテレビジョン受信機に近接して使用されると、受信障害を引き起こすことがあります。
取扱説明書に従って正しい取り扱いをして下さい。

VCCIマークが付いていない場合には、次の点にご注意下さい。

この装置は、情報処理装置等電波障害自主規制協議会（VCCI）の基準に基づくクラスA情報技術装置です　この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

Taiwanese Notice

警告使用者：

這是甲類的資訊產品，在居住的環境中使用時，可能會造成射頻干擾，在這種情況下，使用者會被要求採取某些適當的對策。

Laser Device

All Compaq systems equipped with a laser device comply with safety standards, including International Electrotechnical Commission (IEC) 825. With specific regard to the laser, the equipment complies with laser product performance standards set by government agencies as a Class 1 laser product. The product does not emit hazardous light; the beam is totally enclosed during all modes of customer operation and maintenance.

Laser Safety Warnings

WARNING: To reduce the risk of exposure to hazardous radiation:

- Do not try to open the laser device enclosure. There are no user-serviceable components inside.
- Do not operate controls, make adjustments, or perform procedures to the laser device other than those specified herein.
- Allow only Compaq authorized service technicians to repair the laser device.

Compliance with CDRH Regulations

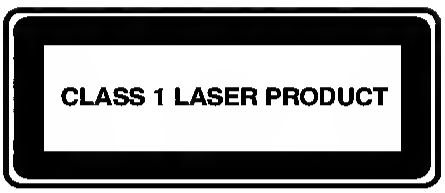
The Center for Devices and Radiological Health (CDRH) of the U.S. Food and Drug Administration implemented regulations for laser products on August 2, 1976. These regulations apply to laser products manufactured from August 1, 1976. Compliance is mandatory for products marketed in the United States.

Compliance with International Regulations

All Compaq systems equipped with laser devices comply with appropriate safety standards including IEC 825.

Laser Product Label

The following label or equivalent is located on the surface of the Compaq supplied laser device.



This label indicates that the product is classified as a CLASS 1 LASER PRODUCT. This label appears on a laser device installed in your product.

Laser Information

Table A-1: Laser Information

Feature	Description
Laser type	Semiconductor GaAlAs
Wave length	780 nm +/- 35 nm
Divergence angle	53.5 degrees +/- 0.5 degrees
Output power	Less than 0.2 mW or 10,869 W m-2 sr-1
Polarization	Circular 0.25
Numerical aperture	0.45 inches +/- 0.04 inches

Battery Replacement Notice

Your Compaq Smart Array 5i Plus Controller and Battery Backed Write Cache Enabler is equipped with a lithium manganese dioxide, vanadium pentoxide, or alkaline internal battery or battery pack. There is a danger of explosion and risk of personal injury if the battery is incorrectly replaced or mistreated. Replacement is to be done by a Compaq authorized service provider using the Compaq spare designated for this product. For more information about battery replacement or proper disposal, contact your Compaq authorized reseller or your authorized service provider.

WARNING: Your computer contains an internal lithium manganese dioxide, vanadium pentoxide, or alkaline battery pack. There is risk of fire and burns if the battery pack is not properly handled. To reduce the risk of personal injury:

- **Do not attempt to recharge the battery.**
- **Do not expose to temperatures higher than 60°C.**
- **Do not disassemble, crush, puncture, short external contacts, or dispose of in fire or water.**
- **Replace only with the Compaq spare designated for this product.**

Batteries, battery packs, and accumulators should not be disposed of together with the general household waste. To forward them to recycling or proper disposal, please use the public collection system or return them to Compaq, your authorized Compaq Partners, or their agents.

B

Electrostatic Discharge

To prevent damaging the system, be aware of the precautions you need to follow when setting up the system or handling parts. A discharge of static electricity from a finger or other conductor may damage system boards or other static-sensitive devices. This type of damage may reduce the life expectancy of the device.

To prevent electrostatic damage, observe the following precautions:

- Avoid hand contact by transporting and storing products in static-safe containers.
- Keep electrostatic-sensitive parts in their containers until they arrive at static-free workstations.
- Place parts on a grounded surface before removing them from their containers.
- Avoid touching pins, leads, or circuitry.
- Always be properly grounded when touching a static-sensitive component or assembly.

Grounding Methods

There are several methods for grounding. Use one or more of the following methods when handling or installing electrostatic-sensitive parts:

- Use a wrist strap connected by a ground cord to a grounded workstation or computer chassis. Wrist straps are flexible straps with a minimum of 1 megohm ± 10 percent resistance in the ground cords. To provide proper ground, wear the strap snug against the skin.
- Use heel straps, toe straps, or boot straps at standing workstations. Wear the straps on both feet when standing on conductive floors or dissipating floor mats.
- Use conductive field service tools.
- Use a portable field service kit with a folding static-dissipating work mat.

If you do not have any of the suggested equipment for proper grounding, have a Compaq authorized reseller install the part.

NOTE: For more information on static electricity, or assistance with product installation, contact your Compaq authorized reseller.

C

Drive Arrays and Fault Tolerance

What Is a Drive Array?

The capacity and performance of a single physical (hard) drive is adequate for home users. However, business users demand higher storage capacities, higher data transfer rates, and greater protection against data loss when drives fail.

Merely adding extra physical drives to the system increases the total storage capacity (see Figure C-1). However, this addition does not affect the efficiency of read/write (R/W) operations, since data can still be transferred to only one physical drive at a time.

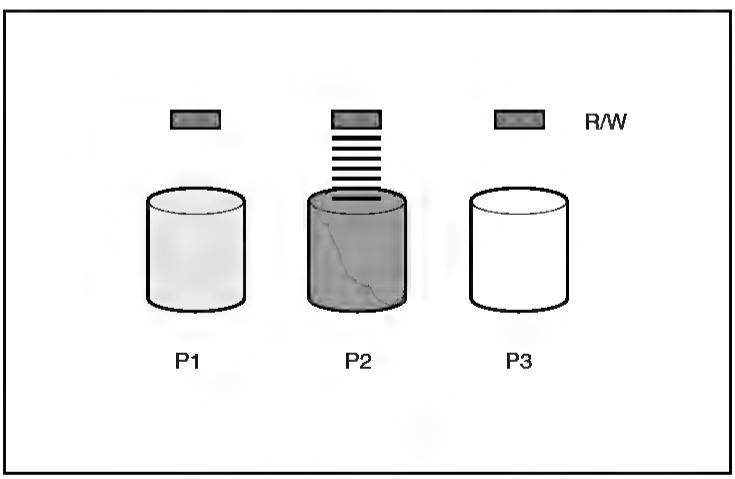


Figure C-1: Physical drives added to system

With an array controller installed in the system, the capacity of several physical drives can be combined into one or more virtual units called **logical drives** (also called logical volumes). Then, the read/write heads of all the constituent physical drives are active simultaneously, reducing the total time required for data transfer.

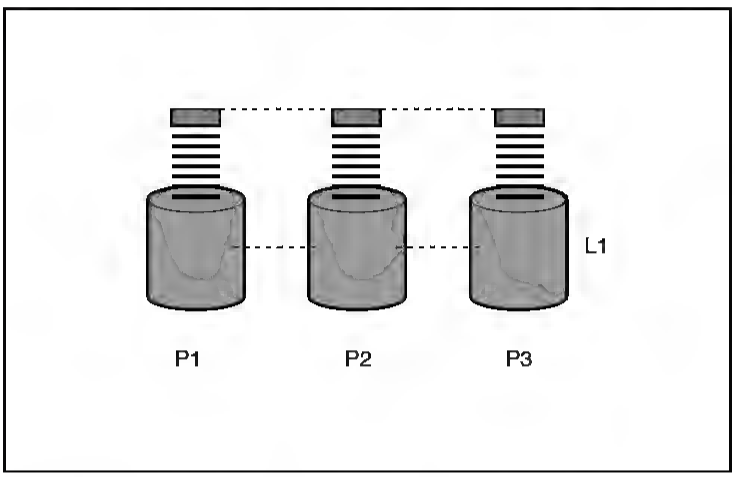


Figure C-2: Physical drives configured into a logical drive (L1)

Because the read/write heads are active simultaneously, the same amount of data is written to each drive during any given time interval. Each unit of data is called a **block,** and over all the physical drives in a logical drive the blocks form a set of data **stripes** (see Figure C-3).

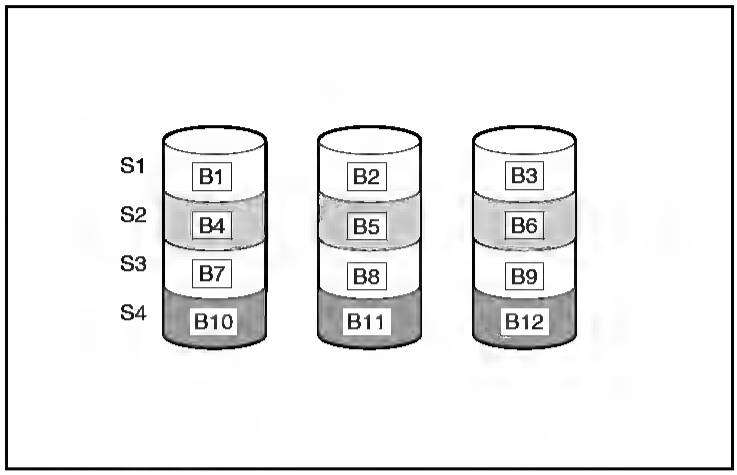


Figure C-3: Data striping (S1-S4) of data blocks B1-B12

For data in the logical drive to be readable, the data block sequence must be the same in every stripe. This sequencing process is performed by the array controller, which sends the data blocks to the drive write heads in the correct order.

A natural consequence of the striping process is that each physical drive in a given logical drive will contain the same amount of data. If one physical drive has a larger capacity than other physical drives in the same logical drive, the extra capacity is wasted because it cannot be used by the logical drive.

The group of physical drives containing the logical drive is called a **drive array,** or simply **array.** Since all the physical drives in an array are commonly configured into just one logical drive, the term array is also often used as a synonym for logical drive. However, an array can contain several logical drives, each of a different size (see Figure C-4).

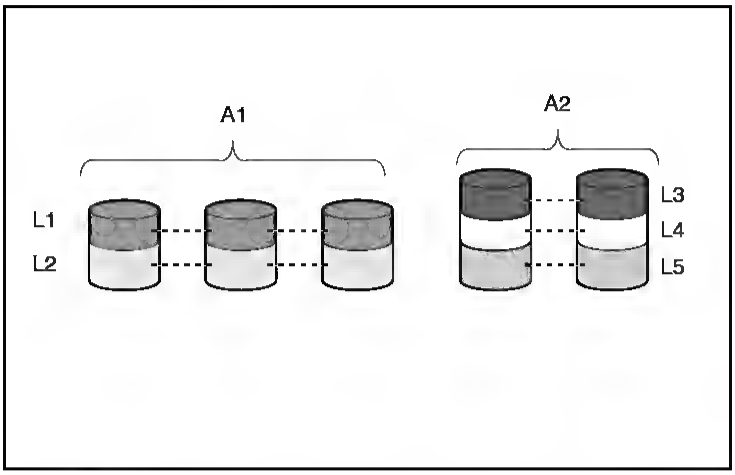


Figure C-4: Two arrays (A1, A2) containing five logical drives spread over five physical drives

Each logical drive in an array is distributed over all of the physical drives within the array. A logical drive can also extend over more than one port on the same controller, but it cannot extend over more than one controller.

Drive failure, although rare, is potentially catastrophic. In Figure C-4, for example, failure of **any** physical drive causes **all** logical drives in the same array to fail, and all data on the drives is lost.

To protect against data loss due to physical drive failure, logical drives are configured with **fault tolerance.** There are several fault-tolerance methods; those supported by current Compaq controllers (and described in the "Fault Tolerance Methods" section) are:

- RAID 0—Data Striping only (no fault tolerance)
- RAID 1+0—Drive Mirroring
- RAID 5—Distributed Data Guarding

For any configuration except RAID 0, further protection against data loss can be achieved by assigning a drive as an **online spare** (or **hot spare**). This drive contains no data and is connected to the same controller as the array. When any other physical drive in the array fails, the controller automatically rebuilds information that was originally on the failed drive onto the online spare. The system is quickly restored to full RAID-level data protection. (However, in the unlikely event that another drive in the array fails while data is being rewritten to the spare, the logical drive will still fail.)

When you configure an online spare, it is automatically assigned to all logical drives in the same array. Additionally, you do not need to assign a separate online spare to each array; you can configure one hard drive to be the online spare for several arrays, as long as the arrays are all on the same controller.

Fault-Tolerance Methods

RAID 0—No Fault Tolerance

This configuration (see Figure C-3) provides no protection against data loss when a drive fails. However, it is useful for rapid storage of large amounts of non-critical data (for printing or image editing, for example), or when cost is the most important consideration.

Advantages

The advantages of RAID 0 are that:

- It is the highest performance method for writes.
- It has the lowest cost per unit of data stored.
- All drive capacity is used to store data (none needed for fault tolerance).

Disadvantages

The disadvantages of RAID 0 are that:

- All data on the logical drive is lost if a physical drive fails.

- You cannot use an online spare.
- You can only preserve data by backing it up to external drives.

RAID 1+0—Drive Mirroring

In this configuration, data is duplicated onto a second drive.

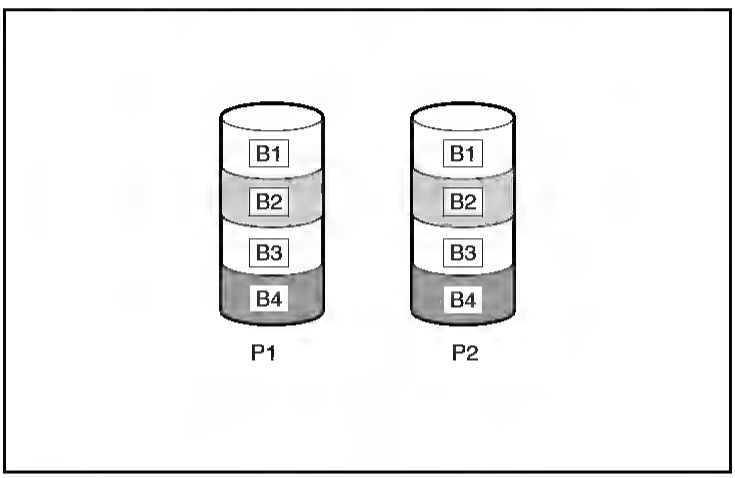


Figure C-5: Drive mirroring of P1 onto P2

When the array has more than two physical drives, drives are mirrored in pairs.

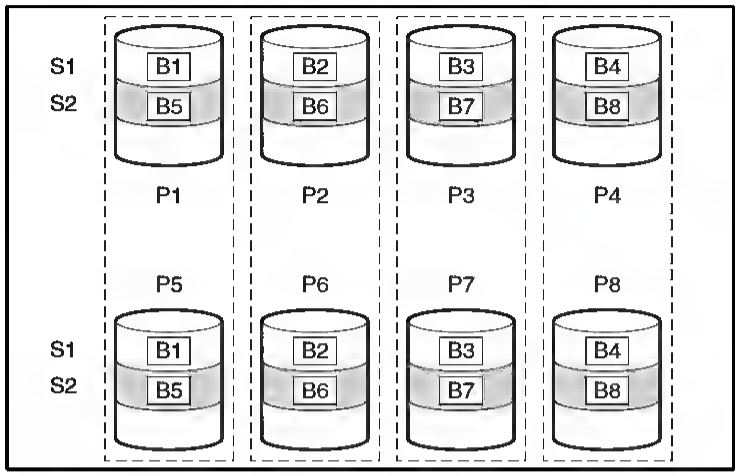


Figure C-6: Mirroring with more than two physical drives in the array

In each mirrored pair, the physical drive that is not busy answering other requests answers any read request sent to the array. (This behavior is called **load balancing.**) If a physical drive fails, the remaining drive in the mirrored pair can still provide all the necessary data. Several drives in the array can fail without incurring data loss, as long as no two failed drives belong to the same mirrored pair.

This fault-tolerance method is useful when high performance and data protection are more important than the cost of physical drives.

NOTE: When there are only two physical drives in the array, this fault-tolerance method is often referred to as RAID 1.

Advantages

The advantages of RAID 1+0 are that:

- It has the highest read and write performance of any fault-tolerant configuration.
- No loss of data occurs as long as none of the failed drives are mirrored to another failed drive (up to half of the physical drives in the array can fail).

Disadvantages

The disadvantages of RAID 1+0 are that:

- It is expensive (many drives are needed for fault tolerance).
- Only 50% of total drive capacity useable for data storage.

RAID 5—Distributed Data Guarding

By this method, a block of **parity data** is calculated for each stripe from the data that is in all other blocks within that stripe. The blocks of parity data are distributed over every physical drive within the logical drive (see Figure C-7). When a physical drive fails, data that was on the failed drive can be calculated from the user data on the remaining drives and the parity data. This recovered data is usually written to an online spare in a process called a **rebuild.**

This configuration is useful when cost, performance, and data availability are equally important.

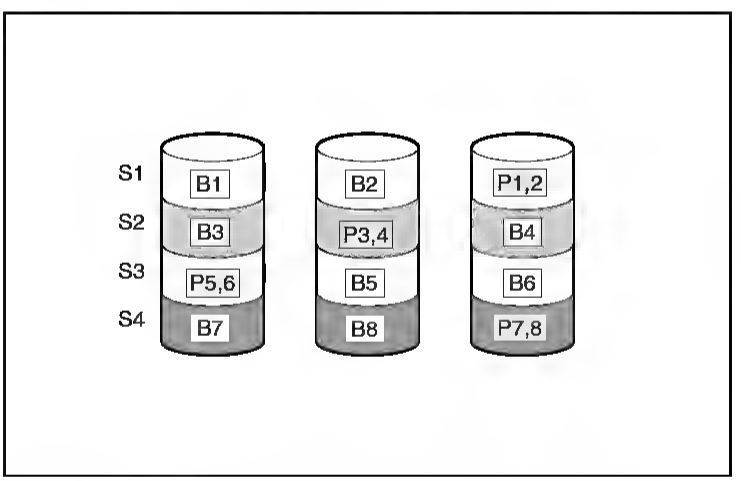


Figure C-7: Distributed data guarding, showing parity information (Px,y)

Advantages

The advantages of RAID 5 are that:

- It has a high read performance.
- No loss of data occurs if one physical drive fails.
- More drive capacity is usable than with RAID 1+0 (parity information requires only the storage space equivalent to one physical drive).

Disadvantages

The disadvantages of RAID 5 are that:

- It has a relatively low write performance.
- Loss of data occurs if a second drive fails before data from the first failed drive is rebuilt.

Table C-1 summarizes the important features of the different kinds of RAID described. The decision chart in Table C-2 may help you to determine which option is best for your situation.

Table C-1: Summary of RAID Methods

	RAID 0	RAID 1+0	RAID 5
Alternative name	Striping (no fault tolerance)	Mirroring	Distributed Data Guarding
Usable drive space*	100%	50%	67% to 93%
Usable drive space formula	n	n/2	(n-1)/n
Minimum number of physical drives	1	2	3

continued

Table C-1: Summary of RAID Methods *continued*

	RAID 0	RAID 1+0	RAID 5
Tolerates failure of one physical drive?	No	Yes	Yes
Tolerates simultaneous failure of >one physical drive?	No	Only if no two failed drives are in a mirrored pair	No
Read performance	High	High	High
Write performance	High	Medium	Low
Relative cost	Low	High	Medium

*Values for usable drive space are calculated with these assumptions:

- All physical drives in the array have the same capacity.
- Online spares are not used.
- No more than 14 physical drives are used for RAID 5. (This number is recommended so that the risk of logical drive failure is kept low. See Appendix D for further information.)

Table C-2: Choosing a RAID Method

Most Important	Also Important	Suggested RAID Level
	I/O performance	RAID 1+0
Cost effectiveness	I/O performance	RAID 5 (RAID 0 if fault tolerance is not required)
I/O performance	Cost effectiveness	RAID 5 (RAID 0 if fault tolerance is not required)
	Fault tolerance	RAID 1+0

Other Fault-Tolerance Options

Your operating system may also support software-based RAID or controller duplexing.

- **Software-based RAID** resembles hardware-based RAID, except that the operating system works with logical drives as if they were physical drives. To protect against data loss caused by physical drive failure, each logical drive must be in a different array from the others.
- **Controller Duplexing** uses two identical controllers with independent, identical sets of drives containing identical data. In the unlikely event of a controller failure, the remaining controller and drives will service all requests.

However, the hardware-based RAID methods described in this appendix provide a much more robust and controlled fault-tolerant environment. Additionally, controller duplexing and software-based RAID do not support online spares, auto-reliability monitoring, interim data recovery, or automatic data recovery.

If you decide to use one of these alternative fault-tolerance options, configure your arrays with RAID 0 for maximum storage capacity and refer to your operating system documentation for further implementation details.

D

Hard Drive Installation and Replacement

Each SCSI channel on a Smart Array controller supports up to 14 drives. Drives can be of the Wide Ultra3 SCSI or Wide Ultra2 SCSI type.

Each drive on a SCSI bus must have a unique ID value in the range 0 to 15 (except ID 7, which is reserved for controller use). This value is set automatically on hot-pluggable drives in Compaq *ProLiant*™ servers and storage systems, but values for other drives must be set manually.

- Do **not** terminate the drives. Compaq servers and internal cabling provide the required termination of the SCSI bus.
- Do **not** use drives of different capacity in the same array. The excess capacity of larger drives cannot be used by the array and is wasted.
- Do **not** combine hot-pluggable drives with non-hot-pluggable drives on the same SCSI bus.

Hard drives that are currently supported by the Smart Array Controller are listed at www.compaq.com/products/storageworks/.

General Information About Hard Drive Failure

When a hard drive fails, all logical drives that are in the same array will be affected. Each logical drive in an array may be using a different fault-tolerance method, so each logical drive can be affected differently.

- RAID 0 configurations cannot tolerate drive failure. If any physical drive in the array fails, all non-fault-tolerant (RAID 0) logical drives in the same array will also fail.

- RAID 1+0 configurations can tolerate multiple drive failures as long as no failed drives are mirrored to one another.
- RAID 5 configurations can tolerate one drive failure.
- RAID ADG configurations can tolerate simultaneous failure of two drives.

If more hard drives fail than the fault-tolerance method allows, fault tolerance is compromised and the logical drive fails. In this case, all requests from the operating system will be rejected with unrecoverable errors. The "Compromised Fault Tolerance" section discusses possible ways to recover from this situation.

Recognizing Drive Failure

The LEDs on the front of each hard drive are visible through the front of the server or external storage unit. When a drive is configured as a part of an array and attached to a powered-on controller, the status of the drive can be determined from the illumination pattern of these LEDs. Table D-1 describes the meaning of the various LED combinations.

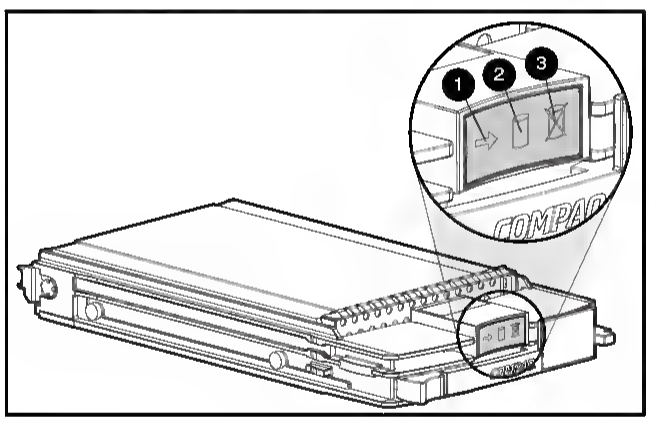


Figure D-1: Hard drive status LED indicators

Table D-1: Interpreting Hard Drive Status from LED Indicator Pattern

(1) Activity	(2) Online	(3) Fault	Meaning
On, off, or flashing	On or off	Flashing	**A predictive failure alert has been received for this drive. Replace the drive as soon as possible.**
Off, on, or flashing	On	Off	OK to replace the drive online if the array is configured for fault tolerance and all other drives in the array are online. The drive is online and configured as part of an array.
On	Flashing	Off	**Do not remove the drive. Removing a drive during this process may terminate the current operation and cause data loss.** The drive is rebuilding or undergoing capacity expansion.
On	Off	Off	**Do not remove the drive. Removing a drive during this process may cause data loss.** The drive is being accessed, but (1) it is not configured as part of an array, (2) it is a replacement drive and rebuild has not yet started, or (3) it is spinning up during POST

continued

Table D-1: Interpreting Hard Drive Status from LED Indicator Pattern *continued*

Flashing	Flashing	Flashing	**Do not remove the drive. Removing a drive during this process can cause data loss in non-fault-tolerant configurations.** Either (1) the drive is part of an array being selected by the Array Configuration Utility, (2) the Options ROMPaq utility is upgrading the drive firmware, or (3) Drive Identification has been selected in Compaq Insight Manager.
Off	Off	On	OK to replace the drive online. The drive has failed and has been placed offline.
Off	Off	Off	OK to replace the drive online if the array is configured for fault tolerance and all other drives in the array are online. Either (1) the drive is not configured as part of an array, (2) the drive is configured as part of an array, but a powered-on controller is not accessing the drive, or (3) the drive is configured as an online spare.

There are several other ways to recognize that a bard drive has failed:

- The amber LED lights up on the front of a Compaq storage system if failed drives are inside. (Other problems such as fan failure, redundant power supply failure, or over-temperature conditions will also cause this LED to light up.)
- A Power-On Self-Test (POST) message lists failed drives whenever the system is restarted, as long as the controller detects one or more good drives. See Appendix G for an explanation of POST messages.
- The Array Diagnostic Utility (ADU) lists all failed drives.
- Compaq Insight Manager can detect failed drives remotely across a network.

Additional information about hard drive problems can be found in the *Compaq Servers Troubleshooting Guide.*

Compromised Fault Tolerance

Compromised fault tolerance commonly occurs when more physical drives have failed than the fault-tolerance method can endure. In this case, the logical volume is failed and unrecoverable disk error messages are returned to the host. Data loss is likely to occur.

An example of this situation is where one drive on an array fails while another drive in the same array is still being rebuilt. If the array has no online spare, any logical drives on the array that are configured with RAID 5 fault tolerance will fail.

Compromised fault tolerance may also be caused by non-drive problems, such as temporary power loss to a storage system or a faulty cable. In such cases, the physical drives do not need to be replaced. However, data may still have been lost, especially if the system was busy at the time that the problem occurred.

Procedure to Attempt Recovery

When fault tolerance has been compromised, inserting replacement drives does not improve the condition of the logical volume. Instead, if your screen displays unrecoverable disk error messages, try the following procedure to recover data.

1. Turn the entire system off and then back on. In some cases, a marginal drive will work again for long enough to allow you to make copies of important files.
2. If a 1779 POST message is displayed, press the **F2** key to re-enable the logical volumes. Remember that data loss has probably occurred and any data on the logical volume is suspect.
3. Make copies of important data, if possible.
4. Replace any failed drives.
5. After the failed drives have been replaced, the fault tolerance may again be compromised. If so, cycle the power again. If the 1779 POST message is displayed, press the **F2** key to re-enable the logical drives, recreate your partitions, and restore all data from backup.

To minimize the risk of data loss due to compromised fault tolerance, make frequent backups of all logical volumes.

Automatic Data Recovery

Automatic Data Recovery is an automatic background process that rebuilds data onto a spare or replacement drive when another drive in the array fails. This process is also called **rebuild.**

If a drive in a fault-tolerant configuration is replaced while the system power is off, a Power-On Self-Test (POST) message is displayed during the next system startup. This message prompts you to press the **F1** key to start Automatic Data Recovery. If Automatic Data Recovery is not enabled, the logical volume remains in a ready-to-recover condition and the same POST message is displayed whenever the system is restarted.

When Automatic Data Recovery has finished, the Online LED of the replacement drive stops blinking and begins to glow steadily.

In general, approximately 15 minutes is required to rebuild each gigabyte. The actual rebuild time depends upon:

- The level of rebuild priority that has been set for the logical drive
- The amount of I/O activity occurring during the rebuild operation
- The disk drive speed
- The number of drives in the array (for RAID 5)

For example, the rebuild time when using 9-GB Wide-Ultra hard drives in a RAID 5 configuration varies from 10 minutes per gigabyte (for 3 drives) to 20 minutes per gigabyte (for 14 drives).

Failure of Automatic Data Recovery

If the Online LED of the replacement drive stops blinking during Automatic Data Recovery, there are three possible causes:

- If the Online LED is glowing continuously, Automatic Data Recovery was successful and has finished.

- If the amber failure LED is illuminated or other LEDs go out, the replacement drive has failed and is producing unrecoverable disk errors.

  Remove and replace the failed replacement drive.

- If the Automatic Data Recovery process has abnormally terminated, one possible cause is a non-correctable read error on another physical drive. The system may temporarily become operational if rebooted. In any case, locate the faulty drive, replace it, and restore data from backup.

General Aspects of Drive Replacement

Before replacing a degraded drive, use Compaq Insight Manager to examine the error counters recorded for each physical drive in the array to verify that such errors are not presently occurring. Refer to the Compaq Insight Manager documentation on the Compaq Management CD for details.

CAUTION: Sometimes, a drive that has previously been failed by the controller may seem to be operational after the system is power-cycled, or (for a hot-pluggable drive) after the drive has been removed and reinserted. However, continued use of such marginal drives may eventually result in data loss. Replace the marginal drive as soon as possible.

There are several other factors to remember when replacing a hard drive:

- Non-hot-pluggable drives should only be replaced while the system is powered down.
- Hot-pluggable drives can be removed and replaced at any time, whether the host or storage system power is on or off.

  When a hot-pluggable drive is inserted, all disk activity on the array pauses while the new drive is spinning up (usually 20 seconds or so). If the drive is inserted while power is on, in a fault-tolerant configuration, data recovery onto the replacement drive begins automatically (indicated by the blinking Online LED).
- Replacement drives must have a capacity no less than that of the smallest drive in the array. Drives of insufficient capacity will be failed immediately by the controller before Automatic Data Recovery can begin.

- When you set the SCSI ID jumpers manually, check the ID value to be sure that the correct physical drive is being replaced. Set the same ID value on the replacement drive to prevent SCSI ID conflicts.

CAUTION: In systems using external data storage, take care that the server is the first unit to be powered down and the last to be powered back up. Doing this ensures that the system will not erroneously mark the drives as failed.

The rebuild operation takes several hours, even if the system is not busy while the rebuild is in progress. System performance and fault tolerance are both affected until the rebuild has finished. Therefore, replace drives during low activity periods whenever possible. In addition, be sure that all logical volumes on the same array as the drive being replaced have a current, valid backup.

Drive Failure During Rebuild

If another drive in the array fails while fault tolerance is unavailable during rebuild, a fatal system error may occur. If this happens, all data on the array is lost. In exceptional cases, however, failure of another drive need not lead to a fatal system error. These exceptions include:

- Failure after activation of a spare drive
- Failure of a drive that is not mirrored to any other failed drives (in a RAID 1+0 configuration)
- Failure of a second drive in a RAID ADG configuration

Minimizing Fatal System Errors During Rebuild

When a hard drive is replaced, the controller gathers fault-tolerance data from the remaining drives in the array. This data is then used to rebuild the missing data (originally on the failed drive) onto the replacement drive. If more than one drive is removed at a time, the fault-tolerance data is incomplete. The missing data cannot then be reconstructed and is likely to be permanently lost.

To minimize the likelihood of fatal system errors, take these precautions when removing failed drives:

- Do not remove a degraded drive if any other member of the array is offline (the Online LED is off). In this condition, no other drive in the array can be removed without data loss.

  There are some exceptions:

  — When RAID 1+0 is used, drives are mirrored in pairs. Several drives can be in a failed condition simultaneously (and they can all be replaced simultaneously) without data loss, as long as no two failed drives belong to the same mirrored pair.

  — When RAID ADG is used, two drives can fail simultaneously (and be replaced simultaneously) without data loss.

  — If an online spare has an unlit Online LED (it is offline), the degraded drive can still be replaced.

- Do not remove a second drive from an array until the first failed or missing drive has been replaced **and** the rebuild process is complete. (When the rebuild is complete, the Online LED on the front of the drive stops blinking.)

  There are some exceptions:

  — In RAID ADG configurations, any two drives in the array can be replaced simultaneously.

  — In RAID 1+0 configurations, any drives that are not mirrored to other removed or failed drives can be simultaneously replaced offline without data loss.

Moving Drives and Arrays

Drives can be moved to other ID positions on the same array controller. You may also move a complete array from one controller to another (even if the controllers are on different servers). However, if you combine arrays that were on different controllers into one larger array on a single controller, the data on the arrays is lost.

IMPORTANT: There are some restrictions on moving an array:

- A drive array that has been moved from a battery backed array controller to one that is not battery backed is no longer able to undergo RAID/stripe size migration, array capacity expansion, or logical drive capacity extension.
- If an array that is configured for RAID ADG is moved to a controller that does not support RAID ADG, it will not be recognized by the new controller.

Before moving drives, these conditions must exist:

- The move will not result in more than 14 physical drives per channel.
- No more than 32 logical volumes will be configured for a controller.
- No drives are failed or missing.
- The array is in its original configuration with no active spare drives.
- Capacity expansion is not running.
- Controller firmware is the latest version (recommended).

If moving an array, all drives in the array must be moved at the same time.

After verifying that the preceding conditions exist:

1. Back up all data before removing any drives or changing configuration. This step is **required** if you are moving data-containing drives from a controller that is not battery backed.
2. Power down the system.
3. Move the drives.
4. Power up the system.

   A 1724 POST message is displayed, indicating that drive positions were changed and the configuration was updated.

   CAUTION: If a 1785 (Not Configured) POST message is displayed, power the system down immediately to avoid data loss, and then return the drives to their original locations.

5. Restore the data from backup if necessary.

You can now check the new drive configuration by running ORCA or the Array Configuration Utility (see Chapter 7 for details).

Upgrading Disk Drive Capacity

You can increase the storage capacity on a system even if there are no available drive bays, as long as a fault-tolerance method is running.

CAUTION: Since a data rebuild takes about 15 minutes per gigabyte, your system is unprotected against drive failure for many hours, or even days, while the rebuild is in progress.

To upgrade disk drive capacity:

1. Back up all data.
2. Replace any drive. The data on the new drive is re-created from redundant information on the remaining drives.

   CAUTION: Do not replace any other drive until data rebuild on this drive is complete.

3. When data on the new drive has been rebuilt (the Activity LED is no longer illuminated), repeat the previous step for the other drives in the array, one at a time.
4. When all drives have been replaced, you can use the extra capacity to create new logical drives or extend existing logical drives.

Expanding and Extending Capacity

Array capacity expansion is the addition of physical drives to an array and the redistribution of the pre-existing logical drives over the enlarged array.

The expansion process is illustrated in Figure D-2, where the original array (containing data) is shown with a dashed border, and the newly added drives are shown unshaded (containing no data). The array controller adds the new drives to the array and redistributes the original logical drives over the enlarged array, using the same fault-tolerance method. If the array has several logical drives, data is redistributed one logical drive at a time.

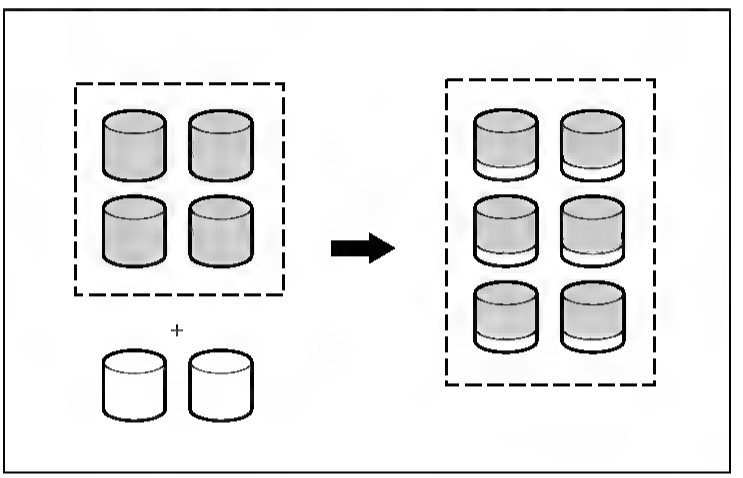


Figure D-2: Array capacity expansion

The unused capacity on the enlarged array can now be used to create an additional logical drive, with a different fault-tolerance setting if necessary.

Alternatively, the unused capacity can be used to increase the size of one of the original logical drives; this process is **logical drive capacity extension**. Another method for carrying out logical drive capacity extension is to delete an existing logical drive and then to add the freed capacity to another logical drive.

Capacity expansion is carried out using one of the utilities described in Chapter 7. For reconfiguration to occur online (that is, without shutting down the operating system), the configuration utility must be running in the same environment as the normal server applications. Also, online expansion is possible only in systems that are using hot-pluggable drives.

Only ACU and ACU-XE support capacity extension. Also, not all operating systems allow extension to be carried out while the system is online (see Chapter 7 for details).

E

Probability of Logical Drive Failure

The probability that a logical drive will fail depends on the RAID level setting.

- A RAID 0 logical drive fails if only one physical drive fails.
- For a RAID 1+0 logical drive, the failure situation is complex.
  - The **maximum** number of physical drives that can fail without causing failure of the logical drive is *n*/2, where *n* is the number of hard drives in the array. This maximum is reached only if no failed drive is mirrored to any other failed drive. In practice, a logical drive usually fails before this maximum is reached. As the number of failed drives increases, it becomes increasingly unlikely that a newly failed drive is not mirrored to a previously failed drive.
  - The failure of **only two** physical drives is enough to cause a logical drive to fail **if** the two drives happen to be mirrored to each other. The risk of this occurring decreases as the number of mirrored pairs in the array increases.
- A RAID 5 logical drive (with no online spare) fails if two physical drives fail.

At any given RAID level, the probability of logical drive failure increases as the number of physical drives in the logical drive increases.

The graph in Figure E-1 provides more quantitative information. The data for this graph is calculated from the mean time between failure (MTBF) value for a typical physical drive, assuming that no online spares are present. Adding an online spare to any of the fault-tolerant RAID configurations further decreases the probability of logical drive failure by a factor of about a thousand.

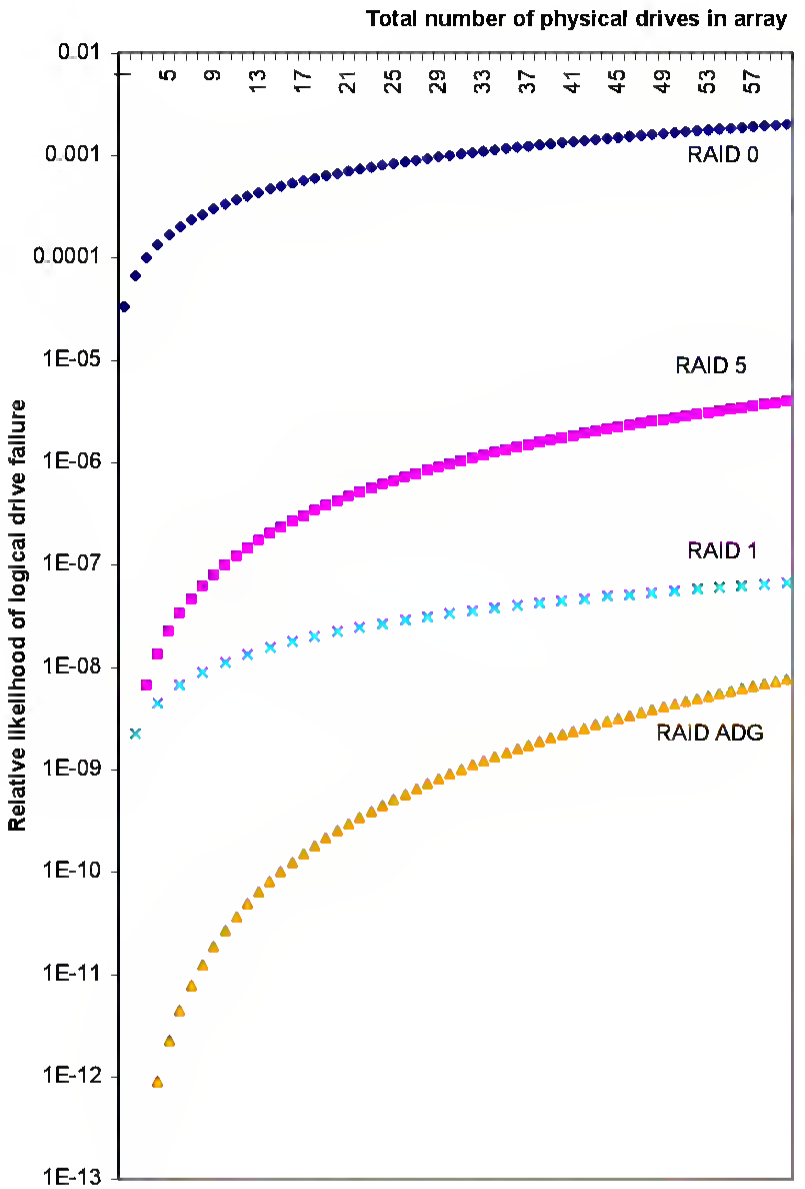


Figure E-1: Probability of logical drive failure

F

POST Error Messages

Smart Array controllers produce diagnostic error messages at reboot. Many of these Power-On-Test (POST) messages are self-explanatory and suggest corrective actions for troubleshooting. Detailed information about these messages is given in Table F-1.

Table F-1: POST Error Messages

Message	Description	Meaning and Recommended Action
1702	SCSI cable error detected. System halted.	There is a termination or cabling problem with the system board integrated SCSI controller. See the cabling information in this guide.
1711	Slot x drive array – RAID ADG logical drives present but cache size is less than or equal to 32 MB.	This configuration is not recommended. Migrate the logical drive (or drives) to RAID 5 or upgrade the array accelerator cache module.
1712	Slot x drive array – RAID 5 logical drives present with 56 drives or more, but cache size is less than or equal to 32 MB.	This configuration is not recommended. Migrate the logical drive (or drives) to RAID 0 or 1, reduce the number of drives in the array, or upgrade the array accelerator cache module.
1713	Slot x drive array – Redundant ROM reprogramming failure.	Replace the controller if this error persists after restarting the system.

continued

Table F-1: POST Error Messages *continued*

Message	Description	Meaning and Recommended Action
1714	Slot x drive array – Redundant ROM checksum error.	Backup ROM has been activated automatically. Check the firmware version.
1720	Slot x drive array – S.M.A.R.T. hard drive detects imminent failure: SCSI port x: SCSI ID y	The indicated drive has reported a S.M.A.R.T. predictive-failure condition. It may fail at some time in the near future. **Do not replace the drive unless all other drives on the array are online.** Back up data before replacing drive(s).
1721	Slot x drive array – drive parameter tracking predicts imminent failure The following device(s) should be replaced when conditions permit: (a list of devices will be given here).	**Do not replace the drive unless all other drives on the array are online.** Back up data before replacing drive(s). M&P predictive failure threshold has been exceeded. The indicated drive(s) may fail at some time in the near future.
1723	Slot x drive array – to improve signal integrity, internal SCSI connector should be removed if external drives are attached to the same SCSI port (followed by further details).	Follow the remaining instructions in the POST message.

continued

Table F-1: POST Error Messages *continued*

Message	Description	Meaning and Recommended Action
1724	Slot x drive array – physical drive position change(s) detected – logical drive configuration has automatically been updated.	Logical drive configuration has been updated automatically following physical drive position changes. Press the **F1** key to resume.
1726	Slot x drive array – array accelerator memory size change detected – array accelerator configuration has automatically been updated	This message is displayed if the controller is replaced with a model that has a different amount of cache memory.
1727	Slot x drive array – new logical drive(s) attachment detected (if >32 logical drives, this message will be followed by **Auto-configuration failed: too many logical drives**)	The controller has detected an additional array of drives that was attached when the system was powered down. The logical drive configuration information has been updated to add the new logical drives. The maximum number of logical drives supported is 32—additional drives will not be added to the configuration if this number is exceeded. Press the **F1** key to resume.
1728	Slot x drive array – abnormal shutdown detected with write cache enabled. No array accelerator battery backup on this model array controller. Any data that may have been in array accelerator memory has been lost.	This message should never occur unless the write cache is somehow enabled on a controller that does not have batteries.

continued

Table F-1: POST Error Messages *continued*

Message	Description	Meaning and Recommended Action
1729	Slot 1 drive array – disk performance optimization scan in progress – RAID 4/5 performance may be higher after completion.	This message is normal following the initial configuration of RAID 4 or RAID 5 logical drives. This POST message will go away and performance of the controller will improve after the parity data has been initialized by ARM (an automatic process that runs in the background on the controller).
1753	Slot x drive array – array controller maximum operating temperature exceeded during previous power up.	This message appears at the next power-up if the controller locks due to excessive temperature. Check for proper operation of the server cooling fan.
1754	Slot z drive array – RAID ADG drive(s) configured but ADG Enabler Module is detached or defective. Please check for detached ADG Enabler Module. Array accelerator is temporarily disabled.	An operational ADG Enabler Module must be attached whenever RAID ADG volumes are configured or the array accelerator will be disabled. Replace the ADG Enabler Module.
1755	Slot z drive array – ADG Enabler Module appears to be defective. Please replace the ADG Enabler Module.	Replace the defective ADG Enabler Module, or remove it if it is not needed (that is, if no RAID ADG logical drives are configured).
1756	Slot x redundant controllers are not the same model.	The redundant controllers are not of the same model. Use two like model controllers for redundancy.

continued

Table F-1: POST Error Messages *continued*

Message	Description	Meaning and Recommended Action
1757	Slot x array accelerator daughter board incompatible. Please replace 4MB array accelerator card with a 16MB or 64MB card.	The controller does not support the attached array accelerator. Attach the correct array accelerator.
1758	Slot x drive array – array accelerator size mismatch between controllers. 64MB array accelerator should be attached to both controllers.	The size of array accelerators is different between two controllers in a redundant controller configuration. Use array accelerators of the same size on both controllers.
1759	Slot x drive array – redundant controller error	Replace the controller or server system board.
1762	Redundant controller operation is not supported in this firmware version. Please remove redundant controller or upgrade controller firmware. (Controller is disabled until this problem is resolved.)	Remove the redundant controller or visit the Compaq website and get the latest upgrade for the controller firmware.
1763	Array accelerator daughter card is detached; please reattach. (Controller is disabled until this problem is resolved.)	This controller model cannot operate if the array accelerator is detached. Reattach the card.

continued

Table F-1: POST Error Messages *continued*

Message	Description	Meaning and Recommended Action
1764	Slot x drive array – capacity expansion process is temporarily disabled (followed by a cause).	The capacity expansion process has been temporarily disabled for the reason indicated and will automatically resume. If the array accelerator has been removed, you must reinstall it for capacity expansion to continue.
1765	Slot x drive array Option ROM appears to conflict with an ISA card – ISA cards with 16-bit memory cannot be configured in memory range C0000 to DFFFF along with SMART-2/E 8-bit Option ROM due to EISA buffer limitations. Please remove or reconfigure your ISA card.	Remove or reconfigure the conflicting ISA card, referring to the directions provided with the ISA card. Alternatively, the Option ROM can be disabled on the SMART-2/E controller through the System Configuration Utility if a SMART-2/E is not the primary (boot) controller.
1766	Slot x drive array requires System ROM upgrade. Run System ROMPaq Utility.	Run the latest version of the System ROMPaq utility.

continued

Table F-1: POST Error Messages *continued*

Message	Description	Meaning and Recommended Action
1768	Slot x drive array – resuming logical drive expansion process.	No action required. This message appears whenever a controller reset or power cycle occurs while array expansion is in progress.
1769	Slot x drive array – drive(s) disabled due to failure during expansion (possibly followed by additional details).	Data has been lost while expanding the array; therefore, the drives have been temporarily disabled. Press the **F2** key to acknowledge the data loss and re-enable the logical drives. Restore data from backup. If the array accelerator has failed, replace the array accelerator board after the capacity expansion process has terminated. **Never** turn off the system and replace the array accelerator if capacity expansion is in progress.
1770	Slot x drive array – critical drive firmware problem detected – please upgrade firmware on the following drive(s) using Options ROMPaq (available from www.compaq.com): SCSI port (y) SCSI ID (*x*)	The indicated drives are running firmware that may cause intermittent problems. Use the Options ROMPaq utility to upgrade firmware on all drives to the latest revision.

continued

Table F-1: POST Error Messages *continued*

Message	Description	Meaning and Recommended Action
1774	Slot x drive array – obsolete data found in array accelerator. Data found in accelerator was older than data found in drives. Obsolete data has been discarded.	Data found on the array accelerator is older than data found on drives due to drives having been disconnected, used on another controller, and then reconnected. Press the **F1** key to discard older data.
1775	Slot x drive array – Proliant storage system not responding SCSI port (y): Check storage system power switch and cables. Power the system down while checking the ProLiant power and cable connections, then power the system back up to retry.	Power the system down. Check the external ProLiant power switch—external drives must all be powered up before or at the same time as the main system. Check cables. If retrying does not help, update the ProLiant system firmware, or try replacing the cable, ProLiant storage backplane, or the array controller.
1776	Slot x drive array – SCSI bus termination error – internal and external drives cannot both be attached to the same SCSI port.	The internal and external connectors of the specified SCSI port(s) are both attached to drives. The SCSI bus is not properly terminated when internal and external drives are attached concurrently to the same SCSI bus. The indicated SCSI bus is disabled until this problem is resolved.
	SCSI port (y): Check the cables	Turn off the server power and check the cabling to the specified SCSI port.

continued

Table F-1: POST Error Messages *continued*

Message	Description	Meaning and Recommended Action
1777	Slot x drive array – ProLiant drive storage enclosure problem detected (followed by one or more of the following): • SCSI port (y): Cooling fan malfunction detected • SCSI port (y): Overheated condition detected • SCSI port (y): Side-panel must be closed to prevent overheating • SCSI port (y): Redundant power supply malfunction detected • SCSI port (y): Wide SCSI transfer failed • SCSI port (y): Interrupt signal inoperative • Check SCSI cables.	Check cooling fan operation by placing hand over the fan. Check the internal plenum cooling fan in tower servers or storage systems. If the fan is not operating, check for obstructions and check all internal connectors. Replace the unit side panel, if it was removed. When the ProLiant Storage System power LED is amber instead of green, the following conditions may be present: • A fan failure • A redundant power supply failure • A thermal problem If the message directs you to check SCSI cables, verify your cabling. If the cable routing is correct, replace cables on the specified port until the POST message is eliminated.
1778	Slot x drive array resuming Automatic Data Recovery process.	No action required. This message appears whenever a controller reset or power cycle occurs while Automatic Data Recovery is in progress.

continued

Table F-1: POST Error Messages *continued*

Message	Description	Meaning and Recommended Action
1779	Slot x drive array – replacement drive(s) detected **or** previously failed drive(s) now appear to be operational: Port (y): SCSI ID (x) Restore data from backup if replacement drive x has been installed.	If this message appears and drive x has not been replaced, an intermittent drive failure has occurred. This message also appears once immediately following drive replacement before data is restored from backup.
1783	Slot x drive array controller failure.	If this message appears immediately following a ROM installation, the ROM is either defective or not installed properly. Check that the controller is firmly inserted in its slot. Check for improper cabling or SCSI ID conflicts. Try upgrading the system ROM. Otherwise, replace the array controller.
1784	Slot x drive array drive failure. The following SCSI drive(s) should be replaced: SCSI port (y) SCSI ID (x)	Check for loose cables. Replace defective drive x and/or cable(s).

continued

Table F-1: POST Error Messages *continued*

Message	Description	Meaning and Recommended Action
1785	Slot 1 Drive Array not Configured (may be followed by one of the following messages): (1) No drives detected (2) Drive positions appear to have changed. Run the Array Diagnostics Utility (ADU) if previous positions are unknown, then turn system power OFF and move drives to their original positions. (3) Configuration information indicates drive positions beyond the capability of this controller. This may be due to drive movement from a controller that supports more drives than the current controller. (4) Configuration information indicates drives were configured on a controller with a newer firmware version.	1. Turn off the system and check SCSI cable connections to be sure that drives are attached properly. 2. Run the Array Diagnostics Utility (ADU) if previous positions are unknown. Then power the system down and move drives to their original positions. 3. To avoid data loss, power the system down and reattach drives to the original controller. 4. To avoid data loss, reattach drives to the original controller or upgrade the controller firmware to the version on the original controller using the Options ROMPaq utility. 5. Press the **F1** key to resume.

continued

Table F-1: POST Error Messages *continued*

Message	Description	Meaning and Recommended Action
1786	Slot x Drive Array Recovery Needed. The following SCSI drive(s) need Automatic Data Recovery: SCSI port (*y*): SCSI ID (*x*) Press the **F1** key to continue with recovery of data to drive(s). Press the **F2** key to continue without recovery of data to drive(s). **-or-** Slot x drive array recovery needed. Automatic Data Recovery previously aborted! The following SCSI drive(s) need Automatic Data Recovery (rebuild): SCSI port (*y*): SCSI ID (*x*) Press the **F1** key to retry Automatic Data Recovery to drive. Press the **F2** key to continue without starting Automatic Data Recovery.	The message normally appears when a drive is replaced in a fault-tolerant configuration when the system is powered down. In this case, press the **F1** key to start the Automatic Data Recovery. The previously aborted version of the 1786 POST message will appear if the previous rebuild attempt was aborted for any reason. Run the Array Diagnostics Utility (ADU) for more information. If the replacement drive was failed, try using another replacement drive. If rebuild was aborted due to a read error from another physical drive in the array: 1. Back up all readable data on the array. 2. Run Diagnostics Surface Analysis. 3. Restore your data.

continued

Table F-1: POST Error Messages *continued*

Message	Description	Meaning and Recommended Action
1787	Slot x drive array operating in Interim Recovery Mode. The following SCSI drive(s) should be replaced: SCSI port (y): SCSI ID (x)	Following a system restart, this message reminds you that drive x is defective and fault tolerance is being used. Replace drive x as soon as possible. A loose or defective cable may also cause this error.
1788	(1) Slot x drive array reports incorrect drive replacement. The following SCSI drive(s) should have been replaced: SCSI port (y): SCSI ID (x). The following SCSI drive(s) were incorrectly replaced: SCSI port (y): SCSI ID (z). Press the **F1** key to continue – drive array will remain disabled. Press the **F2** key to reset configuration – all data will be lost. **-or-** (2) Faulty power cable connection to the drive. **-or-** (3) Defective SCSI cable.	1. The drives indicated were installed in the wrong place, so they have been disabled. Reinstall the drives correctly. Press the **F1** key to restart the computer with the drive array disabled. **-or-** Press the **F2** key to use the drives as configured and lose all the data on them. 2. Repair the connection and press the **F2** key. If this message is not eliminated by pressing the **F2** key, run the Array Diagnostics Utility (ADU). 3. Contact your Compaq authorized service provider.

continued

Table F-1: POST Error Messages *continued*

Message	Description	Meaning and Recommended Action
1789	Slot x drive array physical drive(s) not responding. Check cables or replace the following SCSI drives: SCSI port (y): SCSI ID (x) Press the **F1** key to continue – drive array will remain disabled. Press the **F2** key to fail drives that are not responding – Interim Recovery Mode will be enabled if configured for fault tolerance.	This message indicates that previously operating drives are missing or inoperative following a cold or warm reset. Turn off system and check cable connections. If cables are connected, replace the drive. Press the **F1** key to restart the computer with the drive array disabled. **-or-** If you do not want to replace the drives now, press the **F2** key.
1792	Slot x valid data found in array accelerator. Data automatically written to drive array.	Power was interrupted while the system was in use, or the system was restarted while data was in the array accelerator memory. Power was restored within four days.
1793	Slot x drive array – array accelerator battery depleted. Data in array accelerator has been lost. (Error message 1794 is also displayed.)	While the system was in use, power was interrupted while data was in the array accelerator memory. Power was not restored within four days, so the batteries were depleted and data in the array accelerator was lost. Check all files for potential data corruption. **-or-** The array accelerator batteries have failed.

continued

Table F-1: POST Error Messages *continued*

Message	Description	Meaning and Recommended Action
1794	Slot x drive array – array accelerator battery charge low. Array accelerator is temporarily disabled. Array accelerator will be re-enabled when battery reaches 90% charge. If the battery pack has failed, this message will also be displayed: Array accelerator batteries have failed to charge and should be replaced (Compaq spares #120978-001)	The battery charge is below 90%. Posted writes are disabled. When the batteries are fully recharged, the array accelerator will automatically be re-enabled and this POST message will go away. Replace the array accelerator or array controller if batteries do not recharge within 36 power-on hours. If the battery pack has failed, replace the battery pack.
1795	Slot x drive array – array accelerator configuration error. Data does not correspond to this drive array. Array accelerator is temporarily disabled.	The data stored on the array accelerator does not correspond to this drive array. Match the array accelerator to the correct drive array. **-or-** Run the System Configuration Utility to clear data on the array accelerator.
1796	Slot x drive array – array accelerator is not responding. Array accelerator is temporarily disabled.	Replace the array accelerator or the Smart Array controller.
1797	Slot x drive array – array accelerator read error occurred. Data in array accelerator has been lost. Array accelerator is disabled.	Replace the array accelerator or the Smart Array controller. Restore data from backup.

continued

Table F-1: POST Error Messages *continued*

Message	Description	Meaning and Recommended Action
1798	Slot x drive array – array accelerator write error occurred. Array accelerator is disabled.	Replace the array accelerator or the Smart Array controller. Restore data from backup.
1799	Slot x drive array – drive(s) disabled due to array accelerator data loss. Press the **F1** key to continue with logical drives disabled. Press the **F2** key to accept data loss and re-enable logical drives.	Data stored on the array accelerator has been lost; therefore, the drives have been temporarily disabled. Press the **F2** key to acknowledge the data loss and re-enable the logical drives. Restore data from backup.

G

Questions and Answers

This appendix contains several common questions and answers about the Smart Array 5i Plus Controller and Battery Backed Write Cache Enabler. Where indicated, use the Documentation CD, SmartStart CD, and other user documentation provided with your server or option kit as reference sources. Additional information about Compaq hardware and services is available on the Compaq website, www.compaq.com.

Q. Does the Smart Array 5i Plus Controller and Battery Backed Write Cache Enabler support SCSI tape drives and CD-ROM drives?

A. Yes. The Smart Array 5i Plus Controller and Battery Backed Write Cache Enabler supports Wide Ultra2 SCSI and Wide Ultra SCSI-3 hard drives, as well as tape drive formats such as DLT, DAT, SLR, and AIT.

Q. I installed the hard drives in my server. Must I now terminate each drive?

A. No. If you installed hard drives in a server with a Smart Array 5i Plus Controller and Battery Backed Write Cache Enabler, all termination requirements are met by the controller and the SCSI signal cable. Therefore, the individual drives must have termination removed.

IMPORTANT: This applies to LVDS drives only.

Q. I have several hard drives in my hot-plug drive cage. What SCSI IDs do I assign for these drives?

A. Each hard drive must have a unique SCSI ID for each controller port.

Q. Must SCSI IDs in my system be consecutive?

A. No. The IDs of devices on each SCSI bus are not required to be consecutive. However, IDs must be unique for each device on a single SCSI bus.

CAUTION: Do not interchange SCSI IDs after you configure your Smart Array 5i Plus Controller and Battery Backed Write Cache Enabler. Interchanging the SCSI IDs results in loss of data.

Q. I ordered my server with a preinstalled Smart Array 5i Plus Controller and Battery Backed Write Cache Enabler. Does the server ship with the SCSI cable that I need to connect to my Compaq ProLiant Storage System/U (Model U1, U2, or UE)?

A. No, you will not receive the external SCSI cable with your server. However, the required cable is supplied with the Compaq ProLiant Storage System/U enclosure.

Q. What must I do if I do not understand the POST error message referring to the Smart Array 5i Plus Controller and Battery Backed Write Cache Enabler?

A. First, copy down the POST error message for later reference. A list of POST error messages and definitions is available in the maintenance and service guide for your server or at the Compaq website, www.compaq.com.

At the website, locate your software in the Support area.

After you have defined the error, take the required corrective steps. If you still do not know what to do, run the Array Diagnostics Utility.

Q. Can I use third-party (not manufactured by Compaq) drives on the Smart Array 5i Plus Controller and Battery Backed Write Cache Enabler?

A. Although you can use third-party drives, experience in Compaq testing laboratories reveals that you might have problems, including time-outs and data corruption.

Q. Can I get a Pre-Failure Warranty with third-party drives?

A. No. Compaq can support a Pre-Failure Warranty only through its own tested, integrated storage solutions, and the Compaq Insight Manager utility.

Q. Why do the drive activity lights light up on some drives when my system is idle?

A. The Smart Array 5i Plus Controller and Battery Backed Write Cache Enabler performs several different background activities on the drives when the controller is otherwise idle. For example, the Auto Reliability Monitoring task scans fault-tolerant volumes for defects and verifies the consistency of parity data. The Drive Parameter Tracking task periodically checks the performance of all drives on the controller, normally on an hourly basis.

Glossary

ACU (Array Configuration Utility)
A configuration utility useful for both novices and more experienced RAID users. Obtained either from the SmartStart and Support Software CD or by downloading from the Compaq website (www.compaq.com).

ACU-XE (Array Configuration Utility-XE)
A browser-based version of ACU that can be used remotely on systems that also run Compaq Insight Manager XE.

ADU (Array Diagnostic Utility)
A diagnostic tool that collects comprehensive information about the array controllers in a system and lists any problems detected.

ARM (Auto-Reliability Monitoring)
Also known as surface analysis. A fault management feature whereby hard drives are scanned for bad sectors, and data in the faulty sectors is remapped onto good sectors. Parity data consistency is also checked for drives in RAID 5 or RAID ADG configurations. Operates as a background process.

array
A set of physical drives configured into one or more logical drives. Arrayed drives have significant performance and data protection advantages over non-arrayed drives.

array accelerator
A component of some Smart Array controllers that dramatically improves disk read and write performance by providing a buffer. Data integrity is protected by a backup battery and ECC memory.

array capacity expansion
See capacity expansion.

Automatic Data Recovery (ADR)
Also known as rebuild. A process that automatically reconstructs data from a failed drive and writes it onto a replacement drive. Rebuild time depends on several factors, but at least 15 minutes should be allowed per gigabyte.

cache
A high-speed memory component, used to store data temporarily for rapid access.

capacity expansion
Abbreviated term for array capacity expansion. The addition of physical drives to a pre-existing drive array, and redistribution of existing logical drives and data over the enlarged array. The size of the logical drives does not change. This feature is available only with Compaq array controllers that have a battery backed array accelerator installed.

capacity extension
Abbreviated term for logical drive capacity extension. The enlargement of a logical drive without disruption of data. There must be free space on the array before extension can occur. If necessary, create free space by deleting a logical drive or by carrying out a capacity expansion. Capacity extension can be carried out online with some operating systems.

controller duplexing
A type of fault tolerance that requires two Smart Array controllers. Each controller has its own set of drives, and the drive sets have identical data. When one controller fails, the other automatically takes over the servicing of requests. Controller duplexing is available only for some operating systems.

Compaq Insight Manager
A server management utility capable of collecting, analyzing, and transmitting data about the condition of a server. It is also useful for managing server fault conditions, monitoring server performance, and remotely controlling, reconfiguring, or restarting your system.

Compaq Management Agents
Server-based software that transmits data about the server to SNMP-based management tools, such as Compaq Insight Manager.

CPQONLIN
An array configuration utility for Novell NetWare that can be used while the server is online.

data guarding
See RAID.

data striping
Writing data to logical drives in interleaved chunks (by byte or by sector). This technique improves system performance.

drive mirroring
See RAID.

ECC (error correction and checking) memory
A type of memory that checks and corrects single-bit or multi-bit memory errors (depending on configuration) without causing the server to halt or corrupt data.

fault tolerance
The ability of a server to recover from hardware problems without interrupting server performance or corrupting data. Hardware RAID is most commonly used, but there are other types of fault tolerance—for example, controller duplexing and software-based RAID.

flashing
Updating the flash memory on a system. Flash memory is non-volatile memory that is used to hold control code such as BIOS information. It is also very fast because it can be rewritten block by block, rather than byte by byte.

hot spare
See online spare.

logical drive (or logical volume)
A group of physical drives, or part of a group, that behaves as one storage unit. Each constituent physical drive contributes the same storage volume to the total volume of the logical drive. Has performance advantages over individual physical drives.

logical drive capacity extension
See capacity extension.

LVDS (low voltage differential signaling)
A type of SCSI signaling that allows a maximum transfer rate of either 80 MB/s or 160 MB/s, conforming to either the Wide Ultra2 or Wide Ultra3 SCSI standards respectively.

online spare
Also known as a hot spare, this is a drive in a fault-tolerant system that normally contains no data. When any other drive in the array fails, the controller automatically rebuilds the missing data that was on the failed drive onto the online spare. The controller constructs the missing data from the duplicate or parity data that is on the remaining drives in the array.

ORCA (Option ROM Configuration for Arrays) utility
A ROM-based configuration utility for users who have simple configuration requirements.

POST (Power-On Self-Test)
A series of diagnostic tests that run automatically each time the server is started or reset.

RAID (Redundant Array of Independent Disks)
A form of fault tolerance. RAID 0 (no fault tolerance) uses data striping to distribute data evenly across all physical drives in the array, but has no redundant data. RAID 1+0 (drive mirroring) duplicates data from one drive onto a second drive. RAID 5 (distributed data guarding) distributes parity data across all drives in the array, and uses the parity data and data on remaining drives to reconstruct data from a failed drive. RAID ADG (advanced data guarding) is similar to RAID 5, but uses two independent sets of parity data. See Appendix D for more details.

rebuild
See Automatic Data Recovery.

ROMPaq utility
A utility for updating the system or option firmware, available on the SmartStart and Support Software CD or from the Compaq website (www.compaq.com). Your system must support flashing to be able to take advantage of the ROMPaq utility.

SCSI ID
A unique ID number assigned to each SCSI device connected to a SCSI bus. The ID number determines the device priority on the SCSI bus; ID 7 is the highest priority and is always assigned to the SCSI controller.

SE (Single-Ended)
A type of SCSI signaling that allows a maximum transfer rate of 40 MB/s. Conforms to the Wide-Ultra SCSI standard. Now being phased out in favor of LVD technology.

S.M.A.R.T. (Self-Monitoring And Reporting Technology)
Hard drive firmware that provides advance warning of mechanical drive failure by monitoring critical drive attributes and providing system alerts when an attribute moves out of tolerance.

SmartStart
An abbreviation for the Compaq SmartStart and Support Software CD. A collection of software for updating system drivers, configuring arrays or a system, diagnosing problems with arrays or a system, and updating firmware for the system or options. The latest version of any of these software packages can be obtained by downloading a SoftPaq file from the Compaq website (www.compaq.com). SmartStart can also be used to create or update the system partition on your hard drive.

SNMP (Simple Network Management Protocol)
Governs network management and the monitoring of network devices and functions.

SoftPaq file
A compressed, self-extracting executable file available on the Compaq website that contains the latest version of a particular support software package. Can be downloaded to diskettes or directly to a hard drive.

spare
See online spare.

striping
See data striping.

surface analysis
See ARM.

VHDCI (Very High Density Cable Interconnect)
A type of external SCSI connector used by Ultra SCSI controllers.

Wide Ultra; Wide Ultra2; Wide Ultra3
A set of SCSI standards that support maximum signal transfer rates of up to 40 MB/s, 80 MB/s, and 160 MB/s, respectively.

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